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— COMMITTED TO PROTECTION OF THE ENVIRONMENT —

DRAFT FINAL
DETAILED ANALYSIS
OF ALTERNATIVES REPORT
VERSION 2.0
SOILS DAA
VOLUME III of VII

JULY 1993
CONTRACT NO. DAAA 05-92-D-0002

EBASCO SERVICES INCORPORATED
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THE CONDUCT OF THE FEASIBILITY STUDY (FS) UNDER CERCLA IS ACCOMPLISHED IN TWO STEPS. THE FIRST STEP, THE DEVELOPMENT AND SCREENING OF ALTERNATIVES (DSA), INVOLVES IDENTIFYING AND SCREENING A BROAD SELECTION OF ALTERNATIVES THAT ACHIEVE THE REMEDIAL ACTION OBJECTIVES (ROAS). THE SECOND STEP IS THE DAA. THE OBJECTIVES OF THE DAA INCLUDE THE FOLLOWING: (1) PROVIDE A MORE DETAILED DEFINITION OF EACH ALTERNATIVE RETAINED IN THE DSA, AS NECESSARY, WITH RESPECT TO THE VOLUMES OR AREAS OF CONTAMINATED MEDIA TO BE ADDRESSED, THE TECHNOLOGIES TO BE USED, AND ANY PERFORMANCE REQUIREMENTS ASSOCIATED WITH THOSE TECHNOLOGIES. (2) ASSESS EACH ALTERNATIVE AGAINST THE DAA EVALUATION CRITERIA IDENTIFIED IN THE NATIONAL CONTINGENCY PLAN AND DEFINED IN U.S. EPA GUIDANCE (EPA 1988). (3) PERFORM A COMPARATIVE ANALYSIS AMONG THE ALTERNATIVES TO EVALUATE THE RELATIVE PERFORMANCE OF EACH ALTERNATIVE WITH RESPESCT TO EACH EVALUATION CRITERION. (4) SELECT A PREFERRED ALTERNATIVE FOR EACH MEDIUM GROUP BASED ON THE COMPARATIVE ANALYSIS. THE DAA REPORT CONSISTS OF SEVEN VOLUMES. VOLUME I - EXECUTIVE

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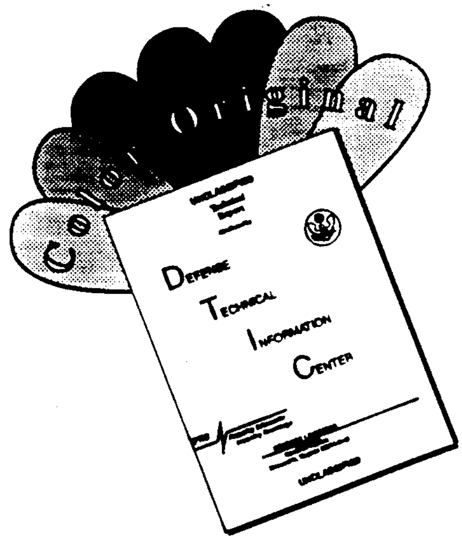

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TECHNICAL SUPPORT FOR
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Prepared for:

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/l	micrograms per liter
3-D	three-dimensional
ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos–containing material
AMC	Army Materiel Command
AOC	Area of Contamination
AOPs	advanced oxidation processes
AR	Army Regulations
ARARs	applicable or relevant and appropriate requirements
Army	U.S. Army
atm-m^3/mol	atmospheres per cubic meters per mole
ATP	Anaerobic Thermal Processor
ATSDR	Agency for Toxic Substances and Disease Registry
BCY	bank cubic yard
BDAT	best demonstrated available technology
BEST	Basic Extraction Sludge Treatment
BFI	Browning Ferris Industries
BOD	Biological Oxygen Demand
BTEX	benzene, toluene, ethylbenzene, and xylenes
BTU	British thermal unit
CAMU	Corrective Action Management Unit
CAR	Contamination Assessment Report
CCA	chromated-copper-arsenate
CCR	Code of Colorado Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CLC2A	Chloroacetic Acid
cm/sec	centimeters per second
cm^2	centimeters squared
COC	contaminant of concern
CPE	chlorinated polyethylene
CPRP	Chemical Personnel Reliability Program
CRL	certified reporting limit
CSI	Conservation Services, Inc.
CSPE	chlorosulfonated polyethylene
CWA	Clean Water Act
CY	cubic yards
DA	Department of the Army
DAA	Detailed Analysis of Alternatives
DADS	Denver Arapahoe Disposal Service, Inc.
db(A)	decibels
DBCP	dibromochloropropane
DCPD	dicyclopentadiene
DDE	dichlorodiphenylethane
DDT	dichlorodiphenyltrichloroethane
DHHS	Department of Health and Human Services
DIMP	diisopropylmethyl phosphorate
DNAPL	dense nonaqueous phase liquid
DOD	Department of Defense

DOT	Department of Transportation
DRE	destruction removal efficiency
DRMO	Defense Reutilization and Marketing Office
DSA	Development and Screening of Alternatives
EA	Endangerment Assessment
Ecology	U.S. Ecology, Inc.
EDSVEP	Enhanced Deep Soil Vapor Extraction Process
ENSCO	Environmental Systems Company
Envirosafe	Envirosafe Services of Idaho, Inc.
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ERC	Ecological Risk Characterization
ESSVEP	Enhanced Surface Soil Vapor Extraction Process
ETTS	Ecotechniek Thermal Treatment System
FC2A	fluoroacetic acid
FFA	Federal Facility Agreement
FML	flexible membrane liner
fpm	feet per minute
FRP	fiber - reinforced plastic
FS	feasibility study
ft/day	feet per day
ft	feet or foot
ft^3	cubic feet
GAA	granulated activated alumina
GAC	granular activated carbon
GB	isopropylmethylphosphonosfluoridate (nerve agent-sarin)
gpm	gallons per minute
H:V	horizontal to vertical
H_2O_2	hydrogen peroxide
HBr	hydrogen bromide
HCCPD	hexachlorocyclopentadiene
HCL	hydrochloric acid
HCPD	Hexachloro pentadiene
HDPE	high-density polyethylene
HE	high explosive
HEP	habitat evaluation protocol
HEPA	high efficiency particulate
HF	hydrofluoric acid
Hg	mercury
HHEA	Human Health Exposure Assessment
HHRC	Human Health Risk Characterization
HI	hazard index
ICP	inductively coupled plasma
ICS	Irondale Containment System
IDLH	Immediately Dangerous to Life and Health
IEA	Integrated Endangerment Assessment
IITRI	IIT Research Institute
IRA	interim response action
IT	International Technology
IWT	International Waste Technologies
K_{oc}	partition coefficient
kw	Kilowatt
kWh	Kilowatt hour

L	Lewisite
lbs	pounds
lbs/acre	pounds per acre
LCY	loose cubic yards
LCY/hr	loose cubic yards per hour
LDR	land disposal restriction
LF	Linear Foot
LNAPL	light nonaqueous phase liquid
LT^3	Low-Temperature Thermal Treatment
LTTA	Low-Temperature Thermal Aeration
mg/l	micrograms per liter
mg/cm^3	milligrams per cubic centimeter
mg/m^3	milligram per cubic meter
mg/kg	milligrams per kilogram
mg/l	microgram per liter
MKE	Morrison–Knudsen Engineering
ml/g	milliliters per gram
mm	millimeters
MMBTU	million British thermal units
mph	miles per hour
MTR	minimum technology requirement
NaOH	sodium hydroxide
NBCS	North Boundary Containment System
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NWBCS	Northwest Boundary Containment System
O&M	operations and maintenance
OAS	Organizations and State
°C	degrees Centigrade
OCP	organochlorine pesticides
OCPD	dicyclopentadiene
°F	degrees Fahrenheit
OPHGB	organophosphorus compounds, GB-agent related
OPHP	organophosphorus Compounds; pesticide related
OSCH	organosulfur compounds; herbicide related
OSCM	organosulfur Compounds; mustard agent related
OSHA	Occupational Health and Safety Administration
PAHs	polynuclear aromatic hydrocarbons
PBC	probabalistic biota criteria
PCB	polychlorinated biphenyls
pcf	pounds per cubic foot
PCP	pentachlorophenol
PEC	plume evaluation criteria
PKPP	potassium pyrophosphate
ppb	parts per billion
PPE	personal protective equipment
PPLV	preliminary pollutant limit value
ppm	parts per million
PRG	preliminary remediation goal
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RAO	remedial action objectives

RCRA	Resource Conservation and Recovery Act
RF	radio frequency
RI	Remedial Investigation
RISR	Remedial Investigation Summary Report
RMA	Rocky Mountain Arsenal
ROD	Record of Decision
RPO	representative process option
SACWSA	South Adams County Water and Sanitation District
SAR	Study Area Report
SARA	Superfund Amendments and Reauthorization Act
SCC	Secondary Combustion Chamber
SEC	Site evaluation criteria
SF	square feet
Shell	Shell Oil Company
SHO	Semivolatile halogenated organics
SITE	Superfund Innovative Technology Evaluation
STC	Silicate Technology Corporation
SVE	soil vapor extraction
SVOCs	semivolatile organic compounds
SY	square yards
T.DI.	Services HT-5
TBC	to be considered
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TEA	triethylamine
TEC	Target Effluent Concentrations
TIS	transportable incineration system
TMV	toxicity, mobility, and volume
TOC	total organic carbon
tpd	tons per day
TSCA	Toxic Substances Control Act
TSD	Treatment Storage and Disposal
TSMG	two-step geometric mean
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USPCI	U.S. Pollution Control, Inc.
UV	ultraviolet
UXO	unexploded ordnance
VAO	volatile aromatic organic compounds
VHC	volatile hydrocarbon compounds
VHO	volatile halogenated organics
VOC	volatile organic compound
VX	ethyl s-dimethyl aminoethyl methyl phosphonothiolate (nerve agent)
WES	Waterways Experimental Station

13.0 DETAILED ANALYSIS OF ALTERNATIVES FOR THE SEWER SYSTEMS MEDIUM GROUP

The Sewer Systems Medium Group consists of nine exceedance sites that are located throughout RMA. The sewer lines in these sites conveyed chemical, sanitary, and process water wastes. Release of contaminants at these sites was caused by spillage or leakage from broken pipes or faulty joints and manholes in the sewer lines. It has been inferred that some of the soils along the piping runs is contaminated, but the actual areas of contamination have not been well documented due to the difficulties in identifying points of leakage without excavating the entire piping runs. The contaminated soils are typically at depths greater than 6 ft below the surface (based on the depth of the sewer piping). These nine sites are subdivided by type and contamination pattern into two subgroups, the Sanitary/Process Water Sewers Subgroup (Figure 13.0-1) and the Chemical Sewers Subgroup (Figure 13.0-2).

The COCs present in this medium group above the Human Health SEC include OCPs, CLC2A, VOCs, DBCP, arsenic, and inductively coupled plasma (ICP) metals. The concentrations of all the COCs for this medium group are below CRLs or the Human Health SEC in the majority of the samples collected. In addition, mercury and OCPs are present at levels exceeding the Biota SEC only in portions of this medium group. The highest concentrations of contaminants—which exceed the principal threat criteria—were detected along the chemical sewer line in site SPSA-10 (South Plants). Sites within this medium group were potential sources of groundwater contamination when in use. Table 13.0-1 contains a summary of the characteristics of this medium group, including the COCs and exceedance volumes, and Appendix A lists the exceedance volumes and areas for the sites within both subgroups.

In the DSA, alternatives were developed and screened based on the general characteristics of the medium group. In the DAA, however, the retained alternatives do not necessarily apply to each subgroup. The characteristics of the two subgroups—including contaminants and contaminant concentrations, site configuration, and depth of contamination—were evaluated to determine the subset of applicable alternatives for each subgroup from the range of alternatives retained in the

DSA for the medium group. For the Chemical Sewers Subgroup, therefore, the retained alternatives were modified primarily to account for the treatment of principal threat areas.

For each subgroup, the following sections present the characteristics of the subgroup, an evaluation of the retained alternatives against the DAA criteria listed in the NCP (EPA 1990), and the selection of a preferred alternative based on a comparative analysis of the alternatives. The preferred alternatives are as follows:

- Sanitary/Process Water Sewers: Alternative 2—Implementation of site access restrictions and plugging of sewer lines to reduce exposure pathways and the potential for migration of contaminants to groundwater.

- Chemical Sewers: Alternative 3a—Excavation of sewer lines and overburden with agent screening during removal of sewer lines. Treatment of soils containing agent by rotary kiln incineration, and direct thermal desorption of principal threat soils. Disposal of remaining soils and sewer debris in the on-post landfill.

13.1 SANITARY/PROCESS WATER SEWERS SUBGROUP CHARACTERISTICS

The Sanitary/Process Water Sewers Subgroup is composed of sites NCSA-8a (Sanitary Sewer Lines), SPSA-11 (Sanitary Sewer System), SPSA-12 (Process Water Lines), and WSA-7a (Sanitary Sewer Sediment). These sites contain soils that were contaminated by spillage or leakage from broken pipes or faulty joints and manholes in the sewer lines. Contamination has entered these sewer lines through inadvertant disposal of liquid wastes or conveyance of contaminated groundwater. The Sanitary/Process Water Sewers are covered by 230,000 BCY of overburden along their 124,000-ft length based on a depth of overburden of at least 6 ft. The majority of sewer piping is vitrified clay, but some sections are comprised of steel or cast-iron pipe. Several of the sanitary sewer lines were plugged as part of the Sanitary Sewers IRA to reduce the conveyance of contaminated groundwater through the sewers.

Table 13.1-1 provides a summary of contaminants, concentrations, and exceedance values for this subgroup. Table 13.1-2 presents a summary of the frequency of detections for samples along the sanitary sewer and process water lines. The exceedances for human health and biota are assumed based on historical information since only 1 sample contained an exceedance of Human Health

or Biota SEC. The assumed COCs of OCPs and ICP metals are based on contaminants frequently detected (Table 13.1-2) which exhibit relatively low Human Health and Biota SEC. Dieldrin and chromium are present in 150,000 BCY of soils in this subgroup at maximum concentrations exceeding the Human Health SEC. Dieldrin is also present at a concentration that exceeds the Biota SEC in 19,000 BCY. Figure 13.1-1 shows the distribution of exceedance areas for this subgroup, and Table 13.0-1 presents the exceedance areas and volumes.

Sites in the Sanitary/Process Water Sewers Subgroup have been identified as historical sources of groundwater contamination. The Sanitary Sewers IRA has reduced the migration of contaminated groundwater by plugging sections of the sewer lines that had been infiltrated by contaminated groundwater which was discharged further down the sewer line. Coordination of alternatives developed for this subgroup with alternatives developed for the water medium is limited to ensuring that any excavation alternatives for the sewer lines do not interfere with groundwater removal systems evaluated for the South Plants and Basin A Plume Groups.

The sites within the Sanitary/Process Water Sewers Subgroup exhibit a range of habitat values from poor to high. In general, the habitat value is considered poor as most of the sewer lines lie within South Plants. However, several segments are located beneath prairie dog colony areas, that are considered high-quality habitat. For most of the alternatives developed for this subgroup, the areas disturbed during remedial actions are revegetated with native grasses in accordance with a refuge management plan. In most instances, the overall habitat is improved, which should offset the short-term loss of habitat resulting from remedial actions. The institutional controls alternative does not impact the existing habitat.

Since 57,000 ft of the Sanitary/Process Water Sewers Subgroup is located within South Plants, the removal of the sewer lines impacts the alternatives developed for the structures and other soils medium groups that include portions of South Plants. To remove the lines in South Plants, some structures need to be demolished and removed to allow access to the sewer lines. Figure 13.1-1 shows the location of the sewer lines in South Plants relative to structures.

Therefore, coordination with the alternatives evaluated for the No future use, Manufacturing History and No Future Use Agent History Medium Groups are required. In addition, the removal of the sanitary/process water requires coordination with other soils medium groups, such as the South Plants Medium Group.

13.2 SANITARY/PROCESS WATER SEWERS SUBGROUP EVALUATION OF ALTERNATIVES

The alternatives for the Sanitary/Process Water Sewers Subgroup vary in approach from no action to treatment. The alternatives retained from the DSA for this subgroup were not modified in the DAA, but the nomenclature was clarified to indicate that solidification is not required following the treatment of organic contaminants. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedances (which is listed first) and an alternative for areas of biota exceedances (the "B" alternative).

13.2.1 Alternative 1/B1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), applies to the estimated 170,000 BCY of human health and biota exceedance volume. Exceedances remain in place, and no action is taken to reduce human or biota exposure to COCs or to reduce potential migration of contaminated groundwater through the sanitary sewer system. Exceedance areas are monitored (an average of 16 total samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants. This alternative does not impact existing habitat. For the portion of this subgroup that is located in South Plants, the alternatives developed for the structures medium are not impacted and can range from no action to demolition and removal.

Table 13.2-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved under this alternative as untreated soils remain in place without controls being initiated, although the residual risk is low due to the low

concentrations of COCs and the depth of contamination. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The predominantly poor-quality habitat at the sites is not changed. The total estimated present worth cost for the alternative is $1,100,000. Table B4.6-1 details the costing for this alternative.

13.2.2 Alternative 2/B1: Access Restrictions

Alternative 2: Access Restrictions (Modifications to FFA), along with Alternative B1: No Additional Action (Provisions of FFA), applies to the estimated 170,000 BCY of human health and biota exceedance volume that remains in place. The estimated 7,000 CY of void space inside sanitary sewer lines and manholes is plugged with a concrete mixture. This closes access to these lines and eliminates them as a potential migration pathway for contaminated groundwater. Exceedance areas are monitored (an average of 16 total samples per year) and 5-year site reviews are conducted to review the effectiveness of the alternative and to assess natural attenuation/degradation and potential migration of contaminants. Due to the linear nature of these sewers, physical barriers or habitat modifications cannot be implemented for this alternative; however, the contaminated soils are at depths more than 6 ft deep, which eliminates nearly all of the potential exposure pathways. None the less, aboveground warning signs are posted every 1,000 ft along sewer lines to indicate their location underground. Information on the sanitary sewer lines is included as part of the ongoing program to educate the public about areas where contaminants are left in place. For the portion of this subgroup that is located in South Plants, the alternatives developed for the structures medium are not impacted and can range from no action to demolition and removal.

Table 13.2-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs by interrupting exposure and minimize the potential for contaminated groundwater migration. Human health and biota exceedances remain in place, although natural attenuation of contamination is ongoing. There is a low residual risk of exposure due to the plugging of sewers, the depth of contamination (more than 6 ft deep), and the low concentrations of contaminants along the length of the sewers. The 210,000 SY of

predominantly poor-quality habitat present in this subgroup is not impacted by this alternative. The plugging of the sewer lines is accomplished within 1 year. The total estimated present worth cost of this alternative is $3,500,000. Table B4.6-2 details the costing for this alternative.

13.2.3 Alternative 3/B3: Landfill

Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill), involves the disposal of 170,000 BCY of contaminated soil and sewer debris. This material is excavated, transported, and placed in the on-post hazardous waste landfill. The on-post landfill is a multiple cell facility requiring 1 year for construction of the first cell and associated facilities (Section 4.6.6). The landfill cover is revegetated to limit erosion and control surface water infiltration, and fencing is installed around the landfill to preserve the integrity of the landfill cover and leachate control system. Long-term maintenance of the landfill cover, leachate collection and treatment, and groundwater monitoring are required.

Prior to excavation of the sewer lines and debris in South Plants, the structures along and above the sewer line are demolished and removed to allow access to the sewers, and the 230,000 BCY of overburden soils are excavated and stockpiled nearby. The excavation is backfilled to the original grade with materials from an on-post borrow area and revegetated with native grasses. As a result, the habitat quality is improved at these sites. The sections of sewer piping constructed out of vitrified clay are crushed during excavation of the sewers, but 94,600 LF of steel and cast-iron pipe are removed from the trench by a backhoe equipped with shears. The pipe is then cut into 2-ft lengths and transported to the landfill for disposal. The removal and sizing of steel and cast-iron pipe results in a volume increase of 1 percent for treatment and/or disposal. No long-term maintenance activities are required along the sanitary/process water sewers excavation because all contaminated soils are removed.

The borrow area is also regraded and revegetated to restore habitat. Abandoned utilities are also removed during the excavation of the South Plants sewer lines, and the debris is combined with the structural debris. The overburden is backfilled upon removal of the piping and contaminants.

Dewatering is not anticipated to be required based on the projected reduction in groundwater elevations after the man-made influence (i.e., leaking sewers) is removed.

Table 13.2-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs since the contaminated soils and sewers are excavated and transferred to a containment cell. The removal of the contaminated soils interrupts exposure pathways and prevents the contamination of groundwater. The disposal of the 170,000 BCY of human health and biota volumes requires approximately 2 years, including a 1-year construction period for the landfill cell. Revegetating the disturbed area with native grasses improves the habitat quality. No site maintenance is necessary, although the landfill requires long-term monitoring. The total estimated present worth cost of this alternative is $14,000,000. Table B4.6–3 details the costing estimate for this alternative.

13.2.4 Alternative 13a/B6: Direct Thermal Desorption

Alternative 13a: Direct Thermal Desorption (Direct Heating), combined with Alternative B6: Direct Thermal Desorption (Direct Heating), treats the 170,000 BCY of contaminated soils and sewer debris in the Sanitary/Process Water Sewers Subgroup. Prior to excavation of the sewer lines and debris in South Plants, the structures along and above the sewer line are demolished and removed to allow access to the sewers, and the 230,000 BCY of sewer overburden are excavated and stockpiled. The sections of sewer piping constructed out of vitrified clay are crushed during excavation of the sewers, but 94,600 LF of steel and cast-iron pipe are removed from the trench by a backhoe equipped with shears. The pipe is then cut into 2-ft lengths and transported to the centralized treatment facilities. The removal and sizing of steel and cast-iron pipe results in a volume increase of 1 percent for treatment and/or disposal. The excavated material is transported to the centralized incineration facility for treatment by thermal desorption. Sewer pipe is crushed prior to entering the thermal desorber.

While removing the sewers from South Plants, abandoned utilities are also removed and combined with the structural debris. Dewatering is not anticipated to be required based on the

projected reduction in groundwater elevations after the man-made influence (i.e., leaking sewers) is removed.

For the saturated soils (20 percent moisture content) expected to be found in this medium group, the thermal desorber operates at a rate of 1,300 BCY/day. The thermal desorber treats and discharges soils and debris at a temperature of 300°C after a total residence time of 50 minutes. When operating under these conditions, the thermal desorber volatilizes all of the mercury and much of the arsenic present in the contaminated soils. Particulates from the quench blowdown, which amount to approximately 1 percent of the total feed, or 1,700 BCY, are placed in the on-post hazardous waste landfill. Section 4.6.24 discusses emission controls for off gases from thermal desorption. The minor chromium exceedance is not treated, but during thermal desorption the materials are homogenized so that the average chromium concentration of the treated soils is less than the Human Health SEC. The treated soils and sewer debris are returned to the site excavation and used as backfill. The stockpiled overburden is used to cover the treated materials since thermal desorption destroys the natural organic content of the soils and makes them less conducive to revegetation. The backfilled areas are revegetated with native grasses, which improves the habitat quality.

Table 13.2-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves both Human Health and Biota RAOs, including the long-term protection of groundwater, since all contaminated soils are treated to remove or destroy the exceedance COCs. The thermal desorption of the 170,000 BCY of contaminated soils and sewer debris requires 3 years, including 2 years for construction and testing of the thermal desorption facility. The impact to biota is minimal due to the linear nature of the sites and the relatively small area of disturbance. Revegetating with native grasses improves the habitat quality of the sites. No site maintenance is necessary as contaminant TMV is removed or destroyed. The total estimated present worth cost of this alternative is $34,000,000. Table B4.6-132 details the costing for this alternative.

13.3 SANITARY/PROCESS WATER SEWERS SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Sanitary/Process Water Sewers Subgroup contains 170,000 BCY of exceedance soils contaminated by spillage or leakage from broken pipes or faulty joints in manholes and sewer lines. Concentrations of dieldrin, and chromium are assumed to exceed the Human Health SEC, and dieldrin is assumed to exceed the (Table 13.0-1). These exceedance soils are estimated to be covered with 230,000 BCY of overburden.

The Sanitary Sewers IRA has reduced the migration of contaminated groundwater through these sewer lines by plugging sections that acted as conduits for contamination. Direct exposure to contaminated soils is restricted by the overburden covering these lines, so the risk posed to humans and biota by this subgroup is low. Personnel protective equipment and site controls are adequate to protect site workers and the community during any intrusive remedial activities.

In general, the habitat at these sites is poor, although some segments are located beneath prairie dog colony areas, that are considered high-quality habitat. Alternatives that involve excavation include revegetation and restoration of habitat, so no significant habitat impacts are anticipated.

In summary, the Sanitary/Process Water Sewers Subgroup contains human health and biota exceedances, but poses a low risk due to the existing overburden and the plugging performed in the Sanitary Sewers IRA to reduce the transport of contaminated groundwater. Habitat impacts and protection of site workers and the community are not significant factors in determining the preferred alternative for this subgroup.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs and is eliminated from further consideration as the preferred alternative. The three remaining alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action-specific and location-specific ARARs for the

DAA. The alternatives differ in how they meet the five balancing criteria (Tables 13.2-1 through 13.2-4).

Alternative 13a: Direct Thermal Desorption achieves RAOs through treatment, but has a higher cost ($34,000,000) than the other two protective alternatives. Both this alternative and Alternative 3: Landfill require the excavation of 230,000 BCY of overburden. Alternative 3 also requires long-term maintenance of the landfill. Alternative 2: Access Restrictions (Modifications to FFA) has the lowest cost for the protective alternatives ($3,500,000). This alternative does not remove the sewer lines, but does achieve RAOs, and minimize the potential for contaminated groundwater migration. The lack of surficial contamination and the implementation of access restrictions reduce the exposure pathways, and plugging the sewer lines reduces the migration of contaminated groundwater.

The preferred alternative for the Sanitary/Process Water Sewers Subgroup is Alternative 2: Access Restrictions. Based on the depth of contamination and the low levels of contamination, this alternative is the most cost-effective alternative for this subgroup. The alternative is consistent with NCP guidance on the use of controls for lower levels of contamination, achieves RAOs, and provides for the long-term protection of groundwater. The selection of access restrictions as the preferred alternative does not impact alternatives developed for the structures or water media and exhibits minimal impact on the other soils medium groups.

13.4 CHEMICAL SEWERS SUBGROUP CHARACTERISTICS

The Chemical Sewers Subgroup is composed of sites CSA-3 (Chemical Sewer), NCSA-6a (South Plants Chemical Sewer), NCSA-6b (North Plants Chemical Sewer), NPSA-1 (Chemical Sewer System), and SPSA-10 (Chemical Sewer System). These sites contain soils contaminated by broken pipes or faulty joints in manholes and sewer lines. High concentrations of contaminants have been detected along the sewer line in South Plants (Site SPSA-10), which exceed the principal threat criteria. In addition, these sites exhibit the potential for agent contamination and

are potential sources of groundwater contamination. The chemical sewers are covered by 340,000 BCY of overburden along their 87,000-ft length based on an average overburden depth of 7 ft.

Table 13.4-1 provides a summary of contaminants, concentrations, and exceedance values for this subgroup. OCPs, CLC2A, DBCP, Hexachlorocyclopentadiene (HCCPD), VOCs, and arsenic are present at maximum concentrations that exceed the Human Health SEC. These COCs were found 7 to 11 ft below ground surface. Approximately 47,000 BCY of soils in site SPSA-10 contain aldrin at concentrations that also exceed the principal threat criteria (10^{-3} excess risk, HI of 1,000). Arsenic, OCPs, and mercury are present at concentrations exceeding the Biota SEC; however, the volume of biota exceedances is contained within the human health exceedance area. Table 13.4-2 presents the frequency of detection for samples collected along the chemical sewer lines. Figure 13.4-1 shows the distribution of exceedance areas for the Chemical Sewers Subgroup, and Table 13.0-1 presents the exceedance areas and volumes. Figure 13.4-2 shows how soils with human health exceedances overlap the area with the potential presence of agent. Most of soils in this subgroup potentially contain agent; however, two segments of the chemical sewer leading to the former Basin F are not anticipated to contain agent.

The Chemical Sewers Subgroup has been identified as an historical source of groundwater contamination. Coordination of alternatives developed for this medium group with those developed for the water medium is limited to ensuring that any excavation of sewer lines does not interfere with groundwater removal systems evaluated for the South Plants and Basin A Plume Groups.

Since the 23,000 LF of principal threat area for the Chemical Sewer Subgroup is located within South Plants, the removal of the sewer lines must be coordinated with the alternatives developed for structures and other soils medium groups in portions of South Plants. The majority of sewer piping is vitrified clay, but some sections are comprised of steel or cast-iron pipe. To remove the lines in South Plants, some structures, such as sumps, need to be demolished and removed

to allow access to the sewer lines. Figure 13.4-1 shows the location of the sewer lines in South Plants relative to structures.

The sites within the Chemical Sewers Subgroup exhibit a range of habitat values from poor to high. In general, the habitat value is considered poor since much of the sewer lines are located within North and South Plants. However, several segments are located beneath prairie dog colony areas, that are considered high-quality habitat. In most of the alternatives developed for this medium group, the areas disturbed during remedial actions are capped as a result of remediation of other adjacent soils medium groups or revegetated with native grasses in accordance with a refuge management plan. In most instances, the overall habitat is improved, which should offset the short-term loss of habitat resulting from remedial actions. The Institutional Controls alternative does not impact the existing habitat.

13.5 CHEMICAL SEWERS SUBGROUP EVALUATION OF ALTERNATIVES

The alternatives for the Chemical Sewers Subgroup vary in approach from no action to treatment. Solvent washing alternatives were screened out in the DSA based on effectiveness and implementability concerns. However, ongoing treatability studies indicate that solvent washing is effective in remaining OCPs and is also applicable to treating soils with agent. As such, Solvent Washing has been reintroduced into the DAA. The nomenclature of alternatives retained in the DSA for this subgroup was modified during the DAA to indicate that solidification is not required following the treatment of organic contaminants, and to account for the treatment of principal threat areas (i.e., Alternative 1a). The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this medium group consist of an alternative to address areas of human health exceedances (which is listed first) and an alternative for areas with potential agent presence (the "A" alternative).

13.5.1 Alternative 1/A1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), combined with Alternative A1: No Additional Action (Provisions of FFA), applies to the 82,000 BCY of human health, exceedance volume, and potential agent volume in this subgroup. These exceedances remain in place, and no action is taken to reduce human or biota exposure to COCs or to reduce potential groundwater migration in the sewers. Exceedance areas are monitored (an average of 16 total samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants. For the portion of this subgroup in South Plants, the alternatives developed for the structures medium are not impacted and can range from no action to demolition and removal.

Table 13.5-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative does not achieve Human Health and Biota RAOs as untreated and uncontained soils remain in place. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The residual risk is only moderate, because although the levels of contamination are high, the risk of exposure is mitigated by the depth of the contamination below the surface. No action is undertaken for potential agent areas. The predominantly poor-quality habitat at the sites is not changed. The total estimated present worth cost for this alternative is $1,100,000. Table B4.7-1 details the costing for this alternative.

13.5.2 Alternative 1a/A1: Direct Thermal Desorption of Principal Threat Volumes; No Additional Action

Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volumes; No Additional Action (Provisions of FFA), along with Alternative A1: No Additional Action (Provisions of FFA), involves treatment of 47,000 BCY of principal threat exceedances in site SPSA-10 of the Chemical Sewers Subgroup and no additional action at other sites in this subgroup.

Due to the potential for odor problems, the excavation of overburden and principal threat soil is conducted so that a minimal area is uncovered and exposed at any one time, and daily soil covers

or plastic sheeting are placed over the excavated areas. Screening for the presence of agent is conducted when the principal threat volume is excavated. The 120,000 BCY of overburden is stockpiled near the excavation. Soils found to be contaminated with agent are excavated and transported to the central incineration facility for treatment by incineration in accordance with Alternative A4 (Section 4.4.4). Prior to excavation of the sewer lines in South Plants, the structures along and above the sewer line are demolished and removed to allow access to the sewers. While removing the chemical sewer system, abandoned utilities are also removed and combined with the structural debris. The sections of sewer piping constructed out of vitrified clay are crushed during excavation of the sewers, but 130,000 LF of steel and cast-iron pipe are removed from the trench by a backhoe equipped with shears. The pipe is then cut into 2-ft lengths and transported to the centralized treatment facilities. The removal and sizing of steel and cast-iron pipe results in a volume increase of 1 percent for treatment and/or disposal. The sewer pipe is sized, crushed, and screened prior to entering the thermal desorber. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevations after the man-made influence (i.e., leaking sewers) is removed.

Materials exceeding principal threat criteria are transported to the central thermal desorption facility for treatment. The thermal desorber operates at a rate of 1,300 BCY/day, assuming that the principal threat soils are saturated (i.e., soil moisture content greater than 20 percent). The thermal desorber treats and discharges soils at a temperature of 300°C with a residence time of 50 minutes. (Section 4.6.23 discusses emission controls for treatment of off gases associated with thermal desorption.) Particulates from quench blowdown amount to approximately 1 percent of the total feed; the 470 BCY of particulates are placed into the on-post hazardous waste landfill. Treated soil and sewer debris is returned and placed in the bottom of the excavation since thermal desorption destroys natural organic content of soil and makes it less conducive to revegetation. The stockpiled overburden is used to cover the treated material and the 49,000 SY of disturbed area is revegetated with native grasses.

No additional action is undertaken for the balance of the sites in the Chemical Sewers Subgroup. An exceedance volume of 35,000 BCY remains in place. No additional action is taken in these areas to reduce human or biota exposure to COCs, to prevent hazards from soils potentially containing agent, or to reduce potential groundwater migration. Exceedance areas are monitored (an average of 16 total samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 13.5-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative does not achieve RAOs as contaminated soils remain in place, although the highest levels of contamination are treated. The potential for exposure to agent-contaminated soils and the potential contamination of groundwater are not fully addressed. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. Treatment of principal threats areas and the significant depth of contamination result in only a moderate residual risk. The time frame for completion of the alternative is 3 years, including 2 years for construction and testing of the centralized thermal desorption facility. The overall poor-quality habitat is not changed. The total estimated present worth cost of this alternative is $11,000,000. Table B4.7-1a details the costing for this alternative.

13.5.3 Alternative 2/A1: Access Restrictions

Alternative 2: Access Restrictions (Modifications to FFA), along with Alternative A1: No Additional Action (Provisions of FFA), involves the initiation of access restrictions for the 82,000 BCY of contaminated sewer lines.

The human health and potential agent exceedance areas in the Chemical Sewers Subgroup are addressed by access restrictions. An exceedance volume of 82,000 BCY remains in place, but contaminant migration pathways are interrupted. An estimated 970 CY of void volume within chemical sewer lines and manholes is filled and plugged with a concrete mixture. This prohibits access into these lines and eliminates them as a potential pathway for groundwater migration. Aboveground warning signs are posted every 1,000 ft along the sewer lines to indicate their

location underground. Information about the chemical sewers is included in an ongoing program to educate the public about areas where contaminants remain in place. Exceedance areas are monitored (an average of 16 total samples per year) and 5-year site reviews are conducted to review the effectiveness of the alternative and to assess natural attenuation/degradation and potential migration of contaminants.

Table 13.5-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs, although contaminated soils remain in place. The potential exposure to agent-contaminated soils and the potential contamination of groundwater are not addressed. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The significant depth of contamination results in only a moderate residual risk. The time frame for completion of the alternative is 1 year. The overall poor-quality habitat is not changed. The total estimated present worth cost of this alternative is $1,500,000. Table B4.7-2 details the costing for this alternative.

13.5.4 Alternative 2a/A1: Direct Thermal Desorption of Principal Threat Volumes; Access Restrictions

Alternative 2a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volumes; Access Restrictions (Modifications to FFA) along with Alternative A1: No Additional Action (Provisions of FFA), involves treatment of 47,000 BCY of principal threat exceedances in site SPSA-10 of the Chemical Sewers Subgroup and the initiation of access restrictions for the remaining sewer lines.

Due to the potential for odor problems, the excavation of overburden and principal threat soil is conducted so that a minimal area is uncovered and exposed at any one time, and daily soil covers or plastic sheeting are placed over the excavated areas. The sections of sewer piping constructed out of vitrified clay are crushed during excavation of the sewers, but 13,000 LF of steel and cast-iron pipe are removed from the trench by a backhoe equipped with shears. The pipe is then cut into 2-ft lengths and transported to the centralized treatment facilities. The removal and sizing

of steel and cast-iron pipe results in a volume increase of 1 percent for treatment. Screening for the presence of agent is conducted when the overburden and principal threat volume are excavated. The 120,000 BCY of overburden are stockpiled near the excavation. Soils found to be contaminated with agent are excavated and transported to the centralized incineration facility for treatment by incineration in accordance with Alternative A4 (Section 4.4.4). Prior to excavation of the sewer lines in South Plants, the structures along and above the sewer line are demolished and removed to allow access to the sewers. While removing the chemical sewer system, abandoned utilities are also removed and combined with the structural debris. The sewer pipe is crushed prior to entering the thermal desorber. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevations after the man-made influence (i.e., leaking sewers) is removed.

Materials exceeding principal threat criteria are transported to the centralized thermal desorption facility for treatment. The thermal desorber operates at a rate of 1,300 BCY/day, assuming the principal threat soils are saturated (i.e., soil moisture content greater than 20 percent). The thermal desorber treats and discharges soils at a temperature of 300°C with a residence time of 50 minutes. (Section 4.6.23 discusses emission controls for treatment of off gases associated with thermal desorption.) Particulates from quench blowdown amount to approximately 1 percent of the total solids feed; the 470 BCY of particulates are placed into the on-post hazardous waste landfill. Treated soils are returned and placed in the bottom of the excavation since thermal desorption destroys natural organic content of the soils and makes it less conducive to revegetation. The stockpiled overburden is used to cover the treated material and the 49,000 SY of disturbed area is revegetated with native grasses.

The remaining human health and potential agent exceedance areas in the Chemical Sewers Subgroup are addressed by the access restrictions part of the alternative. An exceedance volume of 35,000 BCY remains in place, but contaminant migration pathways are interrupted. An estimated 200 CY of void volume within chemical sewer lines and manholes is plugged with a concrete mixture. This prohibits access into these lines and eliminates them as a potential

pathway for groundwater migration. Aboveground warning signs are posted every 1,000 ft along the sewer lines to indicate their location underground. Information about the chemical sewers is included in an ongoing program to educate the public about areas where contaminants remain in place. Exceedance areas are monitored (an average of 16 total samples per year) and 5-year site reviews are conducted to review the effectiveness of the alternative and to assess natural attenuation/degradation and potential migration of contaminants.

Table 13.5-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs, although contaminated soils remain in place, and treats the highest levels of contamination. The potential exposure to agent-contaminated soils and the potential contamination of groundwater are only partially addressed. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. Treatment of principal threat areas and the significant depth of contamination result in only a moderate residual risk. The time frame for completion of the alternative is 3 years, including 2 years required for construction and testing of the centralized thermal desorption facility. The overall poor-quality habitat is not changed. The total present worth cost of this alternative is $13,000,000. Table B4.7-2a details the costing for this alternative.

13.5.5 Alternative 3a/A4: Direct Thermal Desorption of Principal Threat Volumes; Landfill

Alternative 3a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volumes: Landfill (On-Post Landfill), along with Alternative A4: Incineration/Pyrolysis (Rotary Kiln), treats or contains the 82,000 BCY of contaminated soil and sewer debris in the Chemical Sewers Subgroup. The 47,000 BCY of contaminated soils exceeding the principal threat volume criteria in site SPSA-10 is thermally desorbed. The remaining 35,000 BCY of contaminated soil and sewer debris in the Chemical Sewers Subgroup, which exceeds the human health criteria, is placed in the on-post landfill. During the excavation of contaminated soil and sewer debris, agent screening is conducted to identify those soils and debris contaminated with agent. Soils

and debris contaminated with agent are excavated and transported to the rotary kiln incinerator to be incinerated in accordance with Alternative A4 (Section 4.4.4).

The 340,000 BCY of overburden is stockpiled near the excavation. The principal threat volume of 47,000 BCY is excavated and transported to the centralized thermal desorption facility for treatment by thermal desorption. The remaining human health volume of 35,000 BCY is excavated and transported to the on-post hazardous waste landfill. Due to the potential for odor problems, the excavation of overburden, principal threat, and human health exceedance soils is conducted so that minimal area is uncovered and exposed at any one time, and daily soil covers or plastic sheeting are placed over the excavated areas. Prior to excavation of the sewer lines in South Plants, the structures along and above the sewer line are demolished and removed to allow access to the sewers.

The sections of sewer piping constructed out of vitrified clay are crushed during excavation of the sewers, but 13,000 LF of steel and cast-iron pipe are removed from the trench by a backhoe equipped with shears. The pipe is then cut into 2-ft lengths and transported to the centralized treatment facilities. The removal and sizing of steel and cast-iron pipe results in a volume increase of 1 percent for treatment. While removing the chemical sewer system, abandoned utilities are removed and the debris consolidated with the structural debris. Sewer pipe excavated from the principal threat area is crushed prior to entering the thermal desorber for treatment. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevations after the man made influence (i.e., leaking sewers) is removed. The 35,000 BCY of backfill material required to replace the contaminated soil that is contained in the landfill comes from the on-post borrow area.

The thermal desorber operates at a rate of 1,300 BCY/day, assuming the principal threat soils are saturated (i.e., soil moisture content higher than 20 percent). The thermal desorber treats and discharges soils at a temperature of 300°C with a total residence time of 50 minutes. (Section 4.6.23 discusses emission controls for treatment of off gases associated with thermal desorption.)

Particulates from quench blowdown amount to approximately 1 percent of the total feed; these 470 BCY of particulates are placed into the on-post hazardous waste landfill. Treated soil is returned and placed in the bottom of the excavation since thermal desorption destroys the natural organic content and makes them less conducive to revegetation. The stockpiled overburden is used to cover the treated material and the disturbed area is revegetated with native grasses. The borrow area is also revegetated to restore habitat.

The on-post landfill is a multiple cell facility requiring 1 year for construction of the first cell and associated facilities (Section 4.6.6). The landfill cover is revegetated to limit erosion and control surface-water infiltration, and fencing is installed around the landfill to preserve the integrity of the landfill cover and leachate control system. Long-term maintenance of the landfill cover, leachate collection and treatment, and groundwater monitoring are required.

Table 13.5-5 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs since the contaminated soils are treated or contained. The time frame for completion of the alternative is 3 years; 2 years are required for the construction of the landfill and centralized thermal desorber facility and the testing of the thermal desorber. Revegetation with native grasses improves the habitat quality at these sites. No maintenance is required at these sites as all contaminated soil and debris are removed. The landfill requires long-term maintenance and monitoring. The total estimated present worth cost of this alternative is $14,000,000. Table B4.7-3a details the costing for this alternative.

13.5.6 Alternative 8a/A5: Direct Soil Washing

Alternative 8a: Direct Soil Washing (Solvent Washing), along with Alternative A5: Direct Soil Washing (Solvent Washing); Landfill (On-Post Landfill), treats all 82,000 BCY of contaminated soils from Chemical Sewers Subgroup. All contaminated soils and sewer debris are excavated and transported to the centralized facility for treatment by solvent washing. The 340,000 BCY of overburden is excavated and stockpiled near the excavation. During the excavation of contaminated soil and sewer debris, agent screening is conducted to identify those soils and

debris contaminated with agent. Agent-contaminated soils are excavated and treated by solvent washing and subsequently landfilled in accordance with Alternative A5 (Section 4.4.5).

Due to the potential for odor problems, the excavation of overburden and contaminated soils is conducted so that minimal area is uncovered and exposed at any one time, and daily soil covers or plastic sheeting are placed over the excavated areas. Prior to excavation of the sewer lines in South Plants, the structures along and above the sewer line are demolished and removed to allow access to the sewers. While removing the chemical sewer system, abandoned utilities are removed and consolidated with the structural debris. The sections of sewer piping constructed out of vitrified clay are crushed during excavation of the sewers, but 13,000 LF of steel and cast-iron pipe are removed from the trench by a backhoe equipped with shears. The pipe is then cut into 2-ft lengths and transported to the centralized treatment facilities. The removal and sizing of steel and cast-iron pipe results in a volume increase of 1 percent for treatment and/or disposal. This debris is sized and crushed prior to entering the solvent washer for treatment. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevations after the man-made influence (i.e., leaking sewers) is removed.

The 82,000 BCY of excavated soils are treated at a centralized solvent extraction facility. Nine washing cycles are required to achieve Human Health and Biota PRGs, but the solvent is recycled between washing cycles and treated through distillation (Section 4.6.19). A total of 49,000 gallons of liquid effluent are generated and treated at an off-post commercial facility as part of solvent washing. A total of 30 solvent washing units are required to maintain a throughput of approximately 1,200 BCY/day. The treated soils are returned to the excavation as backfill, the stockpiled overburden is used to cover the treated material and the disturbed area is revegetated with native grasses.

Table 13.5-6 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs since all contaminated soils are excavated and treated to remove or destroy the exceedance COCs. The time frame for completion of the alternative is

2 years, 1 of which is required for construction of the landfill and treatment system. Revegetation with native grasses after remediation improves the habitat quality at these sites. Although no maintenance is required at the sites since all contaminated soil and debris is removed, the landfill requires long-term monitoring. The total estimated present worth cost of this alternative is $25,000,000. Table B4.7-8a details the costing for this alternative.

13.5.7 Alternative 13a/A4: Direct Thermal Desorption

Alternative 13a: Direct Thermal Desorption (Direct Heating) along with Alternative A4: Incineration/Pyrolysis (Rotary Kiln), treats all 82,000 BCY of contaminated soils from Chemical Sewers Subgroup. All contaminated soil and sewer debris are excavated and transported to the centralized facility for treatment by thermal desorption. The 340,000 BCY of overburden is excavated and stockpiled near the excavation. During the excavation of contaminated soil and sewer debris, agent screening is conducted to identify those soils and debris contaminated with agent. Agent-contaminated soils are excavated and transported to the rotary kiln incinerator to be incinerated in accordance with Alternative A4 (Section 4.4.4).

Due to the potential for odor problems, the excavation of overburden and contaminated soils is conducted so that minimal area is uncovered and exposed at any one time, and daily soil covers or plastic sheeting are placed over the excavated areas. Prior to excavation of the sewer lines in South Plants, the structures above the sewer line are demolished and removed to allow access to the sewers. While removing the chemical sewer system, abandoned utilities are removed and consolidated with the structural debris. The sections of sewer piping constructed out of vitrified clay are crushed during excavation of the sewers, but 13,000 LF of steel and cast-iron pipe are removed from the trench by a backhoe equipped with shears. The pipe is then cut into 2-ft lengths and transported to the centralized treatment facilities. The debris is sized, crushed, and screened prior to entering the thermal desorber for treatment. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevations after the man-made influence (i.e., leaking sewers) is removed.

The thermal desorber operates at a rate of 1,300 BCY/day, assuming the contaminated soils are saturated (i.e., soil moisture content higher than 20 percent). The thermal desorber treats and discharges soils at a temperature of 300°C with a residence time of 50 minutes. (Section 4.6.23 discusses emission controls for treatment of off gases associated with thermal desorption.) Particulates from quench blowdown amount to approximately 1 percent of the total solids feed; the 820 BCY of particulates are placed into the on-post hazardous waste landfill. Treated soils are returned and placed in the bottom of the excavation since thermal desorption destroys natural organic content of soil and makes it less conducive to revegetation. The stockpiled overburden is used to cover the treated material and the disturbed area is revegetated with native grasses.

Table 13.5-5 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs since all contaminated soils are excavated and treated to remove or destroy the exceedance COCs. The time frame for completion of the alternative is 3 years, including 2 years required for construction and testing of the centralized thermal desorber. Revegetation with native grasses after remediation improves the habitat quality at these sites. No maintenance is required at the sites as all contaminated soil and debris is removed. The landfill requires long-term monitoring. The total estimated present worth cost of this alternative is $17,000,000. Table B4.7-13a details the costing for this alternative.

13.6 CHEMICAL SEWERS SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Chemical Sewers Subgroup consists of 82,000 BCY of exceedance soils where contamination has resulted from leakage or spillage from broken pipes and faulty joints in manholes and sewer lines. Table 13.4-2 summarizes the frequency of detections above Human Health SECs for OCPs, CLC2A, DBCP, HCCPD, VOCs, and arsenic. The principal threat criterion for aldrin is also exceeded by high concentrations in less than 10 percent of the samples collected for the subgroup (Table 13.4-2), resulting in a principal threat exceedance volume of 47,000 BCY.

Most of the chemical sewers have the potential for agent contamination, and 310 BCY of soil is estimated to contain agent. The presence of high levels of OCPs and the potential for agent indicate that protection of site workers and the community is required for alternatives that involve excavation of exceedance soils. The area excavated at any one time is limited and a daily cover or plastic liner is used to reduce odor emissions from the excavations.

In general, the habitat at these sites is poor, although some segments are located beneath prairie dog colony areas that are considered high-quality habitat. Alternatives that involve disturbance of habitat include revegetation and restoration; therefore, significant impacts on habitat are not anticipated.

In summary, the Chemical Sewers Subgroup has human health exceedances, principal threat exceedances, and potential for agent contamination. Selection of the preferred alternative for this subgroup must consider the short-term risks of worker exposure and community impacts from the potential release of vapors versus the longer-term risk of having contamination remain in place.

Alternative 1: No Additional Action does not achieve Human Health RAOs as contaminated soils are left in place without adequate controls. Although the highest levels of contamination are treated, Alternative 1a: Direct Thermal Desorption of Principal Threat Volume; No Additional Action does not achieve Human Health or Biota RAOs as 35,000 BCY of contaminated soils, which potentially contain agent, are not controlled or treated. Therefore, both of these alternatives are eliminated from further consideration as the preferred alternative. All five remaining alternatives use treatment processes to achieve RAOs and meet the two DAA threshold criteria—protection of human health and environment and compliance with action- and location-specific ARARs for the DAA. However, these alternatives exhibit differences in satisfying the five balancing criteria (Tables 13.5-1 through 13.5-5).

Alternative 2: Access Restrictions achieves RAOs but relies on institutional controls and the depth of contamination to prevent exposure to high levels of contamination and agent presence. Alternative 13a: Direct Thermal Desorption and Alternative 8a: Direct Soil Washing treat all of the contaminated soils. Alternative 8a: Direct Soil Washing has the highest cost of the five protective alternatives ($). The other two alternatives treat principal threat areas by thermal desorption. These two alternatives differ in that Alternative 2a: Direct Thermal Desorption of Principal Threat Volume; Access Restrictions leaves some of the contaminated soils in place with only institutional controls to prevent the potential exposure to agent-contaminated soils. Alternative 3a: Direct Thermal Desorption; Landfill includes containment of the soils from the balance of the site in the on-post landfill and the rotary kiln incineration of any soils identified to contain agent. Both Alternative 13a and Alternative 3a require the excavation of 340,000 BCY of overburden to remove the 82,000 BCY of contaminated soils.

The preferred alternative for the Chemical Sewers Subgroup is Alternative 3a: Direct Thermal Desorption of Principal Threat Volume; Landfill. This alternative addresses the principal threat areas and agent-contaminated soils through treatment, while the remaining soils, which have lower levels of contamination, are contained with engineering controls. Therefore, this alternative is cost effective and is consistent with NCP guidance on treatment of higher levels of contamination and the use of engineering controls for lower levels of contamination.

Several structures are demolished prior to excavation within South Plants and North Plants. The structural debris is removed from the area to allow access to the sewers, which limits the range alternatives that may be selected for the structures medium.

Table 13.0-1 Characteristics of the Sewer Systems Medium Group

Characteristic	Sanitary/Process Water Sewers Subgroup	Chemical Sewers Subgroup
Contaminants of Concern		
Human Health	OCPs, ICP metals	OCPs, DBCP, CLC2A, HCCPD, volatiles, As
Biota	OCPs	OCPs[1], Hg[1]
Exceedance Area (SY)		
Total	210,000	100,000
Human Health	190,000	100,000
Biota	19,000	0
Potential Agent	0	74,000
Potential UXO	–	–
Exceedance Volume (BCY)		
Total	170,000	82,000
Human Health	150,000	82,000
Organic	150,000	82,000
Inorganic	18,000	47,000
Principal Threat	0	47,000
Biota	19,000	0
Potential Agent	0	310
Potential UXO	–	–
Depth of Contamination (ft)		
Human Health	7–8	5-10
Biota	7–10	–

[1] Biota contaminants of concern are only present as overlap within human health exceedance areas.

As	Arsenic	ft	Feet
BCY	Bank Cubic Yard	ICP	Inductively Coupled Plasma
CLC2A	Chloroacetic Acid	OCP	Organochlorine Pesticide
DBCP	Dibromochloropropane	UXO	Unexploded Ordnance
		HCCPD	Hexachlorocyclopentadiene

Table 13.1-1 Summary of Concentrations for the Sanitary/Process Water Sewers Subgroup

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–100	NA	56	560	0.68
Dieldrin	BCRL–100	NA	40	400	0.83
Chromium	BCRL–81	NA	40	10,000	–
Biota Exceedance Volume					
Dieldrin	BCRL–2.0	NA	40	400	0.83

Table 13.1-2 Frequency of Detections for Sanitary/Process Water Sewers Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	54	53	98.1%	1	1.9%	0	0.0%	0	0.0%	0	0.0%
Benzene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	47	46	97.9%	1	2.1%	--	--	0	0.0%	0	0.0%
Chloroacetic Acid	45	45	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	39	39	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	54	53	98.1%	1	1.9%	0	0.0%	0	0.0%	0	0.0%
p,p,DDT	54	53	98.1%	1	1.9%	0	0.0%	0	0.0%	0	0.0%
Dibromochloropropane	53	53	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	53	53	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	54	51	94.4%	3	5.6%	0	0.0%	0	0.0%	0	0.0%
Endrin	54	53	98.1%	1	1.9%	0	0.0%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	54	54	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Isodrin	54	54	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Methylene Chloride	34	27	79.4%	7	20.6%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Toluene	39	39	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	54	43	79.6%	10	18.5%	1	1.9%	0	0.0%	0	0.0%
Cadmium	49	48	98.0%	1	2.0%	--	--	0	0.0%	0	0.0%
Chromium	49	8	16.3%	41	83.7%	--	--	0	0.0%	0	0.0%
Lead	49	41	83.7%	8	16.3%	--	--	0	0.0%	0	0.0%
Mercury	52	51	98.1%	1	1.9%	0	0.0%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 13.2-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the Sanitary/Process Water Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants through natural attenuation; potential groundwater impacts not reduced beyond existing IRA measures.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sanitary/Process Water Sewers Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. Low levels of ICP metals and OCPs above Human Health SEC and OCPs above Biota SEC remain in subsurface soils.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility except by natural attenuation; 170,000 BCY of untreated soils remain.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $1,100,000
d) Total	d) $1,100,000

Table 13.2-2 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative B1: No Additional Action (Provisions of FFA) for the Sanitary/Process Water Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs as human and biota exposure pathways interrupted through access restrictions and biota controls; groundwater impacts reduced as sewers plugged.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Table A-25)	a) Complies with action-specific ARARs as access adequately controlled and site reviews conducted; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sanitary Process Water Sewers Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. OCPs and ICP metals above Human Health SEC and OCPs above Biota SEC remain in soils at depth; plugging, land-use restrictions, and depth of contamination reduce exposure.
b) Adequacy and reliability of controls	b) Adequate controls. Installation of plugging and land-use restrictions reduce human exposure; long-term maintenance, site reviews and groundwater monitoring required.
c) Habitat improved	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative. (Area within South Plants may also be capped for soils remediation.)
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility except by natural attenuation; human exposure and biota pathways interrupted over 210,000 SY by land-use restrictions and plugging of sewers.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Exposure controls reversible if controls fail.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative. Contaminants remain in place.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during plugging of sewer lines.
b) Protection of community during remedial action	b) Protective of community.. Dust and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater reduced through plugging.
d) Time until RAOs are achieved	d) 1 year. Plugging of sewer lines feasible within 1 year; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; additional remedial actions easily undertaken for soils left in place although removal of 230,000 BCY of overburden required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for sewer line plugging.

Table 13.2-2 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative B1: No Additional Action (Provisions of FFA) for the Sanitary/Process Water Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) \$3,000
b) Operating	b) \$2,400,000
c) Long-term	c) \$1,100,000
d) Total	d) \$3,500,000

Table 13.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the Sanitary/Process Water Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing potential human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-8)	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sanitary/Process Water Sewers Subgroup and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 170,000 BCY of untreated soil contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat improved	c) Habitat quality improved at site. Revegetation of disturbed poor-quality habitat improves habitat at site (although area within South Plants may be capped for soils remediation) but eliminates habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 170,000 BCY in on-post landfill.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with this alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impacts on biota due to extremely linear nature of site and existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 2 years. Excavation of 170,000 BCY feasible within 1 year after 1 year for construction of landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; additional remedial actions require removal of landfill cover; excavation of 230,000 BCY of overburden soils required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Materials (including clay), specialists, and equipment, readily available for construction of landfill; landfills well demonstrated at full scale.

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $3,500,000
b) Operating	b) $7,600,000
c) Long-term	c) $690,000
d) Total	d) $14,000,000

Table 13.2-4 Evaluation Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the Sanitary/Process Water Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to OCP detection levels and chromium reduced below Human Health SEC; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, and A-10)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sanitary/Process Water Sewers Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 170,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed poor-quality habitat improves habitat quality, offsetting habitat loss during excavation (area within South Plants may also be capped for soils remediation).
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 170,000 BCY thermally desorbed to degrade OCPs.
b) Degree and quantity of TMV reduction	b) OCPs reduced below detection levels (>99.99% destruction removal efficiency); TMV of OCPs eliminated; chromium reduced below Biota SEC following solids blending as a pre-treatment; scrubber blowdown solids from off-gas treatment equipment with chromium and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 1,700 BCY of blowdown solids landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated from excavation; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to extremely linear nature of site and existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 170,000 BCY feasible within 1 year after 2 years for construction thermal desorption facility and landfill.

Table 13.2-4 Evaluation Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the Sanitary/Process Water Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; dewatering required; excavation of 230,000 BCY of overburden soils required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; materials, specialists, and equipment, readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $4,500,000
b) Operating	b) $29,000,000
c) Long-term	c) $6,000
d) Total	d) $34,000,000

Table 13.4-1 Summary of Concentrations for the Chemical Sewers Subgroup

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–20,000	Not Available	56	560	0.68
Dieldrin	BCRL–200	Not Available	40	400	0.83
Isodrin	BCRL–1,000	Not Available	3.4	3,400	not applicable
p,p,DDT	BCRL–500	Not Available	26	1,300	1.4
CLC2A	BCRL–230	Not Available	74	74,000	not applicable
DBCP	BCRL–32,000	Not Available	24	2,400	not applicable
HCCPD	BCRL–4,000	Not Available	1,300	NA	not applicable
Carbon Tetrachloride	BCRL–200	Not Available	25	2,200	not applicable
Chloroform	BCRL–400	Not Available	350	49,000	not applicable
Arsenic	BCRL–740	Not Available	530	5,300	16.5
Endrin[1]	BCRL–9.0	Not Available	15	15,000	0.029
p,p,DDE[1]	BCRL–7.0	Not Available	130	1,300	0.2
Mercury[1]	BCRL–8.8	Not Available	470	470,000	0.99
Biota Exceedance Volume					
None	not applicable	not applicable	not applicable	not applicable	not applicable

1 Present above Biota SEC only, but was detected in the human health exceedance volume

Table 13.4-2 Frequency of Detections for Chemical Sewers Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	122	99	81.1%	9	7.4%	5	4.1%	0	0.0%	9	7.4%
Benzene	58	58	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	55	50	90.9%	3	5.5%	--	--	2	3.6%	0	0.0%
Chlordane	90	89	98.9%	1	1.1%	--	--	0	0.0%	0	0.0%
Chloroacetic Acid	34	33	97.1%	0	0.0%	--	--	1	2.9%	0	0.0%
Chlorobenzene	55	52	94.5%	3	5.5%	--	--	0	0.0%	0	0.0%
Chloroform	55	47	85.5%	8	14.5%	--	--	0	0.0%	0	0.0%
p,p,DDE	111	104	93.7%	7	6.3%	0	0.0%	0	0.0%	0	0.0%
p,p,DDT	111	104	93.7%	5	4.5%	0	0.0%	2	1.8%	0	0.0%
Dibromochloropropane	122	116	95.1%	2	1.6%	--	--	2	1.6%	2	1.6%
1,2-Dichloroethane	55	55	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	87	87	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	122	85	69.7%	25	20.5%	9	7.4%	3	2.5%	0	0.0%
Endrin	122	96	78.7%	15	12.3%	11	9.0%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	111	111	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Isodrin	122	106	86.9%	8	6.6%	--	--	8	6.6%	0	0.0%
Methylene Chloride	38	37	97.4%	1	2.6%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	55	46	83.6%	9	16.4%	--	--	0	0.0%	0	0.0%
Toluene	58	50	86.2%	7	12.1%	--	--	0	0.0%	0	0.0%
Trichloroethylene	55	55	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	91	64	70.3%	18	19.8%	8	8.8%	0	0.0%	0	0.0%
Cadmium	56	53	94.6%	3	5.4%	--	--	0	0.0%	0	0.0%
Chromium	56	20	35.7%	36	64.3%	--	--	0	0.0%	0	0.0%
Lead	56	37	66.1%	19	33.9%	--	--	0	0.0%	0	0.0%
Mercury	92	75	81.5%	9	9.8%	8	8.7%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 13.5-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants through natural attenuation; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Chemical Sewers Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. High levels of DBCP and OCPs above Human Health and Biota SEC and principal threat criteria, but contaminated soils at depths greater than 7 ft; potential agent presence remains.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative. (Area within South Plants may also be capped for soils remediation.)
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility except by natural attenuation; 82,000 BCY of untreated soils remain; no reduction in hazards for agent presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction; soils with potential agent remain in place.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $1,100,000
d) Total	d) $1,100,000

Table 13.5-2 Evaluation of Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain without controls implemented, although principal threat volume treated. Long-term reduction in toxicity of contaminants through natural attenuation for balance of areas; principal threat volume treated to organic detection levels and inorganics reduced below Biota SEC; blowdown solids placed in on-post landfill; potential groundwater impacts not reduced except for principal threat volume.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Chemical Sewers Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. 47,000 BCY thermally desorbed and returned to the site as backfill; CLC2A present in remaining soil but at depths greater than 7 ft.; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill; principal threat volume screened for agent during excavation; potential agent presence remains in sewer lines not removed.
b) Adequacy and reliability of controls	b) No controls implemented for balance of site, but adequate controls for particulates; site reviews and groundwater monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality not improved for balance of site; habitat restored for principal threat area through revegetation (area within South Plants may also be capped for soils remediation); existing poor-quality habitat for balance of site not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 47,000 BCY of principal threat volume thermally desorbed to degrade OCPs, DBCP, CLC2A, HCCPD, and volatiles and remove mercury; no reduction in hazards from agent in remaining soils.
b) Degree and quantity of TMV reduction	b) Organics reduced below detectable levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic reduced below Human Health SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with arsenic, mercury, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 470 BCY of blowdown solids with mercury, arsenic, and salts landfilled.

Table 13.5-2 Evaluation of Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent screening, excavation, transportation, and treatment of principal threat volume.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by daily soil covers or plastic liner; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to linear nature of sites and existing poor-quality habitat; migration of contaminants to groundwater not reduced except for principal threat areas.
d) Time until RAOs are achieved	d) >30 years. Excavation and treatment of 47,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility; natural attenuation of untreated soils ongoing; soils with potential agent remain on site.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; additional remedial actions easily undertaken for soils left in place; 120,000 BCY of overburden soils excavated.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for landfill construction; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) \$1,200,000
b) Operating	b) \$8,600,000
c) Long-term	c) \$1,000,000
d) Total	d) \$11,000,000

Table 13.5-3 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative A1: No Additional Action (Provisions of FFA) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through interruption of human and biota exposure pathways through access restrictions and biota controls; potential groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, A-17, and A-25)	a) Complies with action-specific ARARs; access adequately controlled and site reviews conducted; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Chemical Sewers Subgroup; not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. Highest levels of OCPs and DBCP above Human Health SEC at depth; fencing and land-use restrictions reduce exposure; potential agent presence remain.
b) Adequacy and reliability of controls	b) Adequate controls. Human exposure pathways interrupted by fencing and land-use restrictions; controls adequate for small area; long-term monitoring, site reviews, groundwater monitoring, and monitoring of wildlife exclusion required;
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative. (Area within South Plants may also be capped for soils remediation.)
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No reduction of contaminant volume or mobility except by natural attenuation for 82,000 BCY of soils; human exposure pathways interrupted over 100,000 SY by land-use restrictions and fencing; no reduction in hazards for agent presence beyond controls.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Exposure controls reversible if fencing fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during fence installation.
b) Protection of community during remedial action	b) Protective of community. Dust and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 1 year. Installation of sewer plugs and signs within 1 year; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; additional remedial actions easily undertaken for soils left in place although overburden would require removal.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Readily available. Equipment, specialists, and materials readily available for fence installation.

Table 13.5-3 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative A1: No Additional Action (Provisions of FFA) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $3,000
b) Operating	b) $370,000
c) Long-term	c) $1,100,000
d) Total	d) $1,500,000

Table 13.5-4 Evaluation of Alternative 2a: Direct Thermal Desorption (Direct Heating); Access Restrictions (Modifications to FFA); Alternative A1: No Additional Action (Provision of Principal Threat Volumes of FFA) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment of principal threat volume and interruption of human and biota exposure pathways through access restrictions and biota controls for balance of area; principal threat volume treated to organic detection levels and inorganics reduced below Biota SEC; blowdown solids placed in on-post landfill; potential groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, A-17, and A-25)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; access adequately controlled and site reviews conducted; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Chemical Sewers Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. Highest levels of OCPs and DBCP above Human Health SEC at depth; fencing and land-use restrictions reduce exposure; 47,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill; principal threat volume screened for agent presence during excavation; potential agent presence remain for sewer lines not removed.
b) Adequacy and reliability of controls	b) Adequate controls. Human exposure pathways interrupted by fencing and land-use restrictions; controls adequate for small area; long-term monitoring, site reviews, groundwater monitoring, and monitoring of wildlife exclusion required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat improved for principal threat area through revegetation. (Area within South Plants may also be capped for soils remediation.)
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 47,000 BCY of principal threat volume thermally desorbed to degrade OCPs, DBCP, CLC2A, HCCPD, and volatiles and remove mercury; no reduction of contaminant volume or mobility except by natural attenuation for 35,000 BCY of soils remaining; human exposure pathways interrupted over 100,000 SY by land-use restrictions and fencing; no reduction in hazards for agent presence in remaining soils beyond controls.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic reduced below Human Health SEC following solids blending as a pretreatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with arsenic, mercury, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible; exposure controls reversible if fencing fails.
d) Type and quantity of treatment residuals	d) 470 BCY of blowdown solids with arsenic, mercury, and salts landfilled.

Table 13.5-4 Evaluation of Alternative 2a: Direct Thermal Desorption (Direct Heating); Access Restrictions (Modifications to FFA); Alternative A1: No Additional Action (Provision of Principal Threat Volumes of FFA) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during fence installation, agent screening, excavation, transportation, and treatment of principal threat volume.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liner; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 47,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility and landfill; installation of sewer plugs and signs within 1 year; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; 120,000 BCY of overburden soils excavated; additional remedial actions easily undertaken for soils left in place although overburden would require removal.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for fence installation and landfill construction; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $1,200,000
b) Operating	b) $11,000,000
c) Long-term	c) $1,000,000
d) Total	d) $13,000,000

Table 13.5-5 Evaluation of Alternative 3a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment of principal threat volume and containment of balance of area; principal threat volume treated to organic detection levels and inorganics reduced below Biota SECs balance of area contained in on-post landfill, preventing exposure; blowdown solids placed in on-post landfill; potential groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, A-11, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Chemical Sewers Subgroup, treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 47,000 BCY thermally desorbed and returned to site as backfill; 35,000 BCY of untreated soil contained in on-post landfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill; 310 BCY of soils with agent treated by incineration.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat at site (area may also be capped for soils remediation), but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 47,000 BCY of principal threat volume thermally desorbed to degrade OCPs, DBCP, CLC2A, HCCPD, and volatiles and remove mercury; exposure pathways interrupted and mobility of contaminants reduced through containment of 35,000 BCY in on-post landfill; 310 BCY of soils with agent identified and incinerated.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic reduced below Human Health SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20% to 30%); scrubber blowdown solids from off-gas treatment equipment, arsenic, mercury, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible; mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) 470 BCY of blowdown solids with arsenic, mercury, and salts landfilled.

Table 13.5-5 Evaluation of Alternative 3a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent screening, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liner; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat and extreme linear nature of site; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 47,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility and incinerator for agent treatment; landfilling of 35,000 BCY feasible within 1 year after 1 year for construction of landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; 340,000 BCY of overburden soil excavated; additional remedial action would require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, ard materials readily available for construction of landfill; thermal desorbers, and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $1,900,000
b) Operating	b) $11,000,000
c) Long-term	c) $120,000
d) Total	d) $14,000,000

Table 13.5-6 Evaluation of Alternative 8a: Direct Soil Washing (Solvent Washing); Alternative A5: Direct Soil Washing (Solvent Washing) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to organic detection levels; potential groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, and A-23)	a) Complies with action-specific ARARs including state regulations on air emissions sources, treatment facilities, and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Chemical/Sewers Subgroup and treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 82,000 BCY treated by solvent washing and returned to site as backfill; 310 BCY treated by caustic washing the landfilled; 46,000 gallons of liquid effluent from solvent washing drummed and transported off-post for treatment.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 82,000 BCY solvent washed to degrade OCPs.
b) Degree and quantity of TMV reduction	b) Organics reduced below PRGs (>99.99% destruction removal efficiency); TMV of organics eliminated.
c) Irreversibility of TMV reduction	c) TMV reduction by solvent washing irreversible.
d) Type and quantity of treatment residuals	d) 310 BCY of treated soils with agent landfilled; 46,000 gallons of liquid effluent from solvent washing drummed and transported off-post for treatment.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent clearance, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated from excavation; vapor emissions associated with solvent washer controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impact. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 2 years. Excavation and treatment of 82,000 BCY feasible within 2 years based on a facility of 30 solvent washing units.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter, but 30 treatment units required for facility; landfill cell monitored.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment units and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Available. Limited vendor sources available for solvent washing unit; solvent washing well demonstrated at full scale, but for units with limited throughput.

Table 13.5-6 Evaluation of Alternative 8a: Direct Soil Washing (Solvent Washing); Alternative A5: Direct Soil Washing (Solvent Washing) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) \$1,700,000
b) Operating	b) \$23,000,000
c) Long-term	c) \$2,000
d) Total	d) \$25,000,000

Table 13.5-7 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to below organic detection levels, and inorganics reduced below Biota SEC; blowdown solids placed in on-post landfill; potential groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, A-11, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A. Table A-2)	b) Complies with location-specific ARARs as Chemical Sewers Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 82,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill; 310 BCY of soils with agent incinerated.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation. (Area within South Plants may also be capped for soils remediation.)
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 82,000 BCY thermally desorbed to degrade OCPs, DBCP, CLC2A, HCCPD, and volatiles and remove mercury; 310 BCY of soils with agent identified and incinerated.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic reduced below Human Health SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20% to 30%); scrubber blowdown solids from off-gas treatment equipment with arsenic, mercury, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 820 BCY of blowdown solids with arsenic, mercury, and salts landfilled.

Table 13.5-7 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Chemical Sewers Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent screening, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liner; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impact. Minimal impact to biota due to existing poor-quality habitat and extreme linear nature of site; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 82,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility, incinerator for agent treatment, and landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitored; 340,000 BCY of overburden soil excavated.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $860,000
b) Operating	b) $16,000,000
c) Long-term	c) $3,000
d) Total	d) $17,000,000

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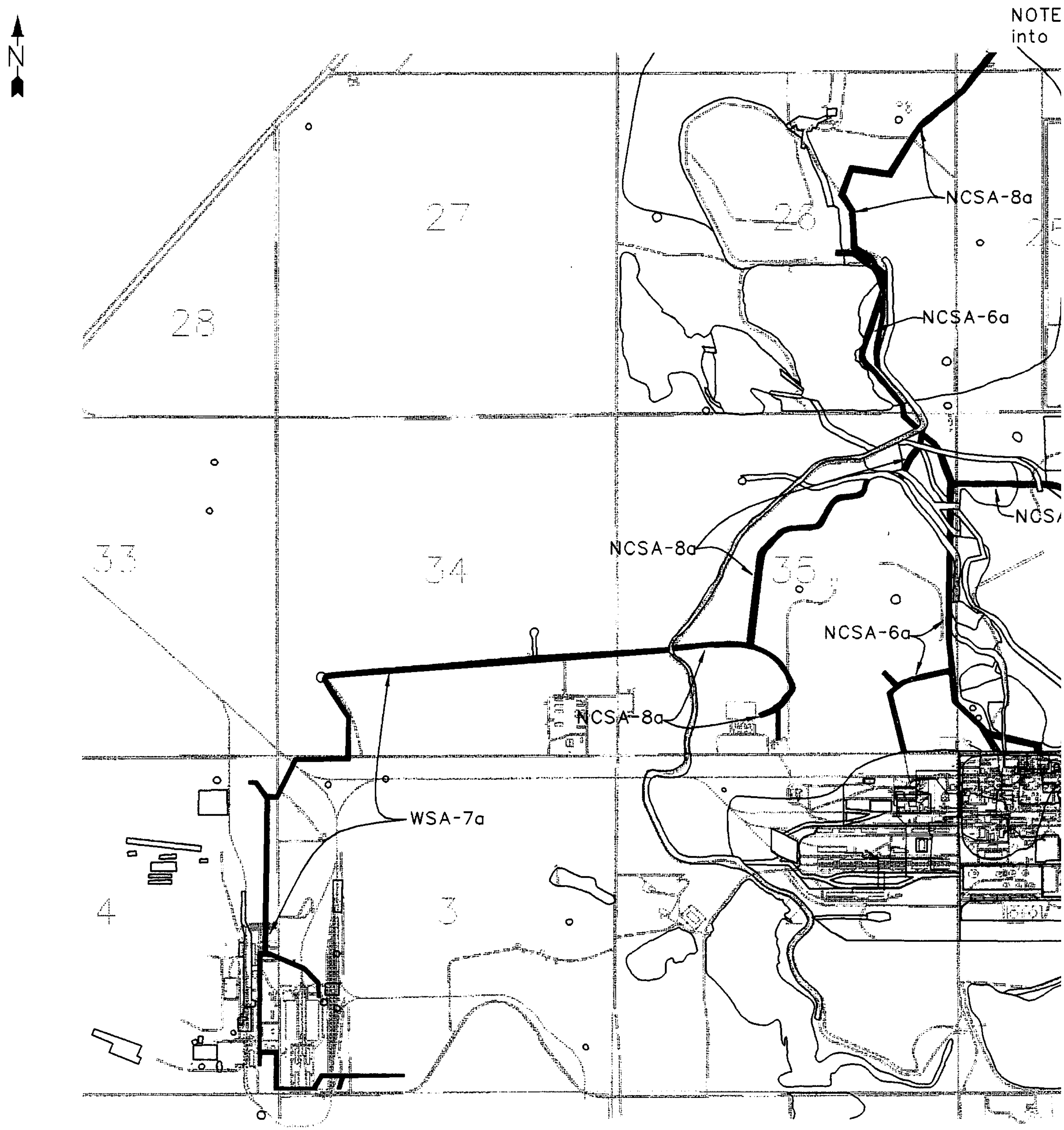
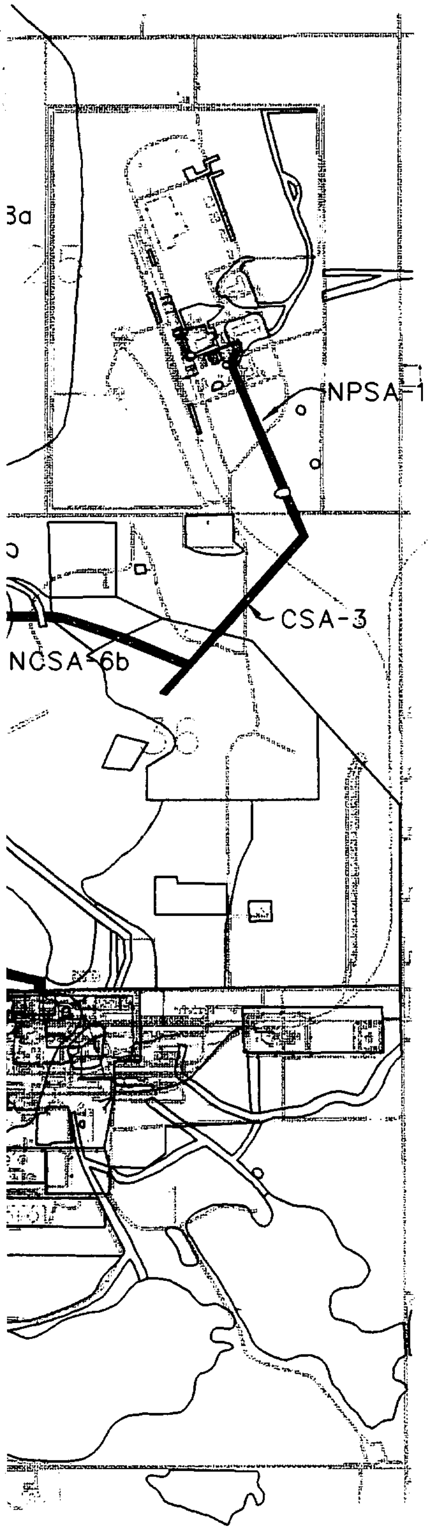
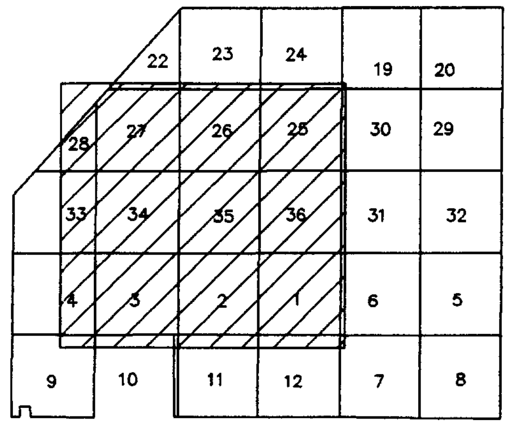


NOTE: Site NCSA 8a Continues Northeast
nto Section 24 to NCSA-8b



ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Sanitary/Process Water Sewers Subgroup
Sites: NCSA-8a, Sanitary Sewer Lines
* SPSA-11, Sanitary Sewer System
* SPSA-12, Process Water Lines
WSA-7a, Sanitary Sewer Sediment

Chemical Sewers Subgroup
Sites: CSA-3, Chemical Sewer
NCSA-6a, South Plants Chemical Sewer
NCSA-6b, North Plants Chemical Sewer
* NPSA-1, Chemical Sewer System
* SPSA-10, Chemical Sewer System

* North Plants and South Plants Sewer Systems not Completely Shown

Site Boundary

Buildings and Roads

27 Section Number

Sanitary Sewer

Chemical Sewer

1000 0 1000 2000 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 13.0-1

Site Locations
Sewer Systems Medium Group

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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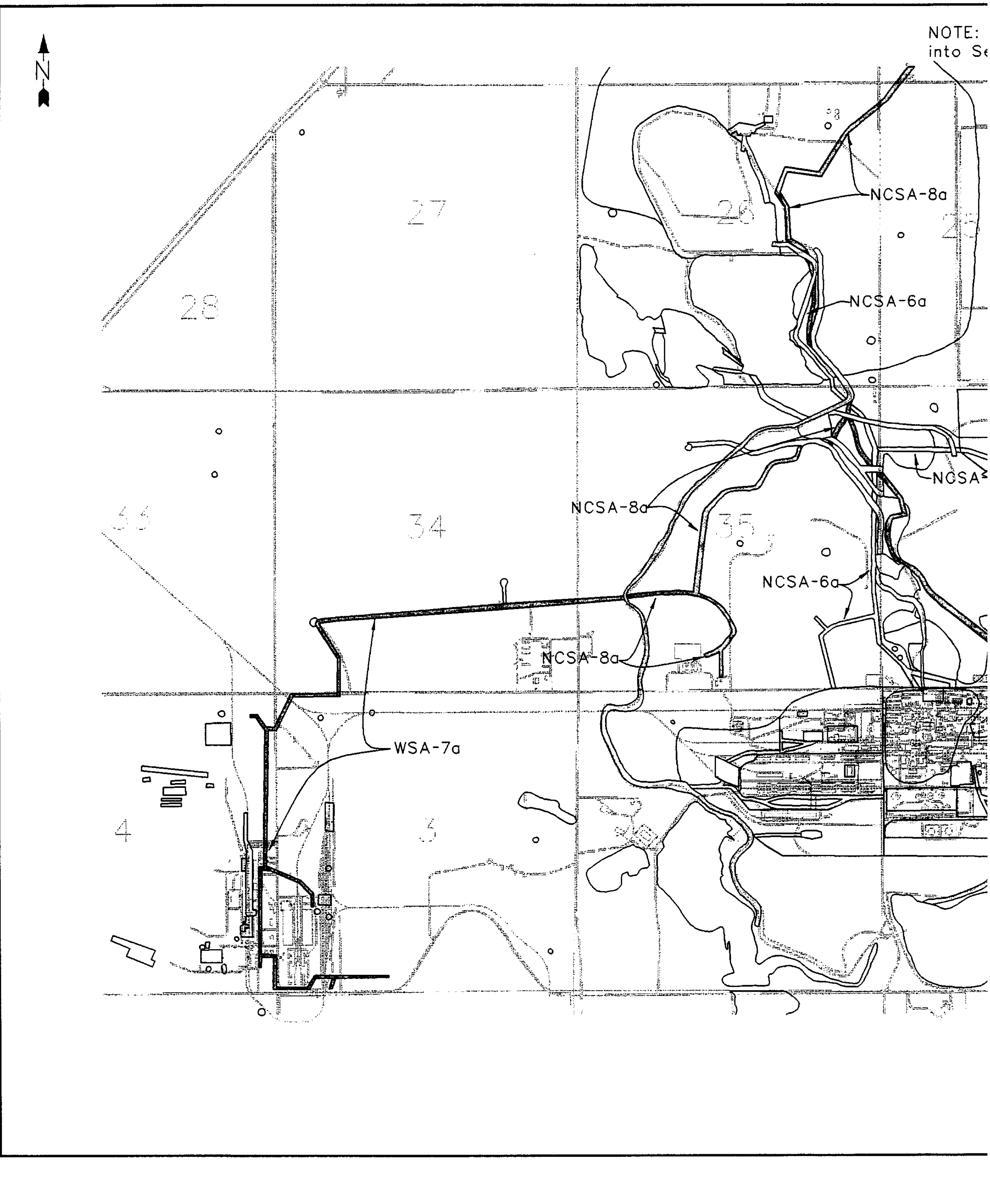
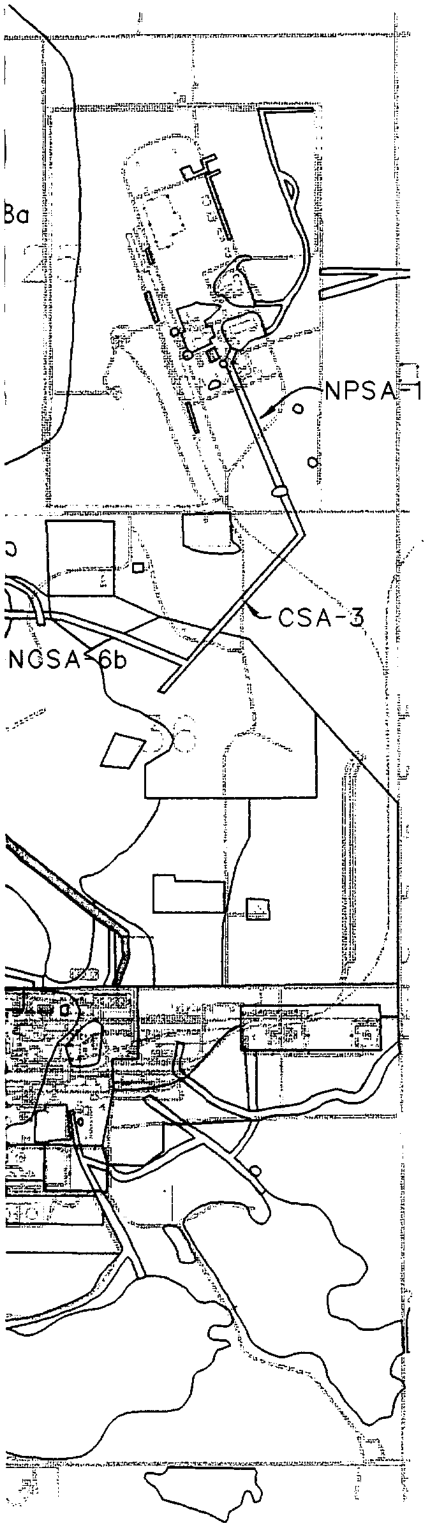
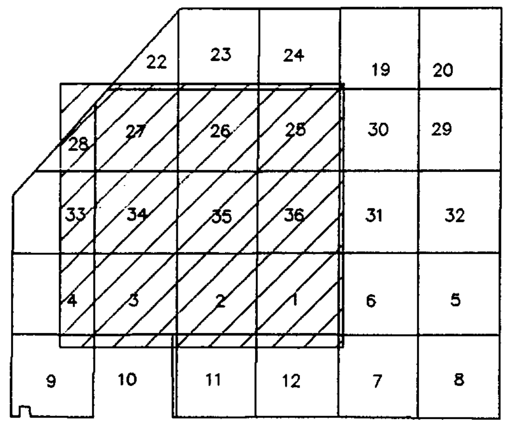


NOTE: Site NCSA 8a Continues Northeast into Section 24 to NCSA-8d



ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Biota Exceedance Area

Human Health Exceedance Area

Site Boundary

Buildings and Roads

27 Section Number

Sewer Main

NOTE: South Plants Sewer System Shown as Solid Lines

1000 0 1000 2000 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 13.1-1

Exceedance Areas
Sanitary/Process Water Sewers
Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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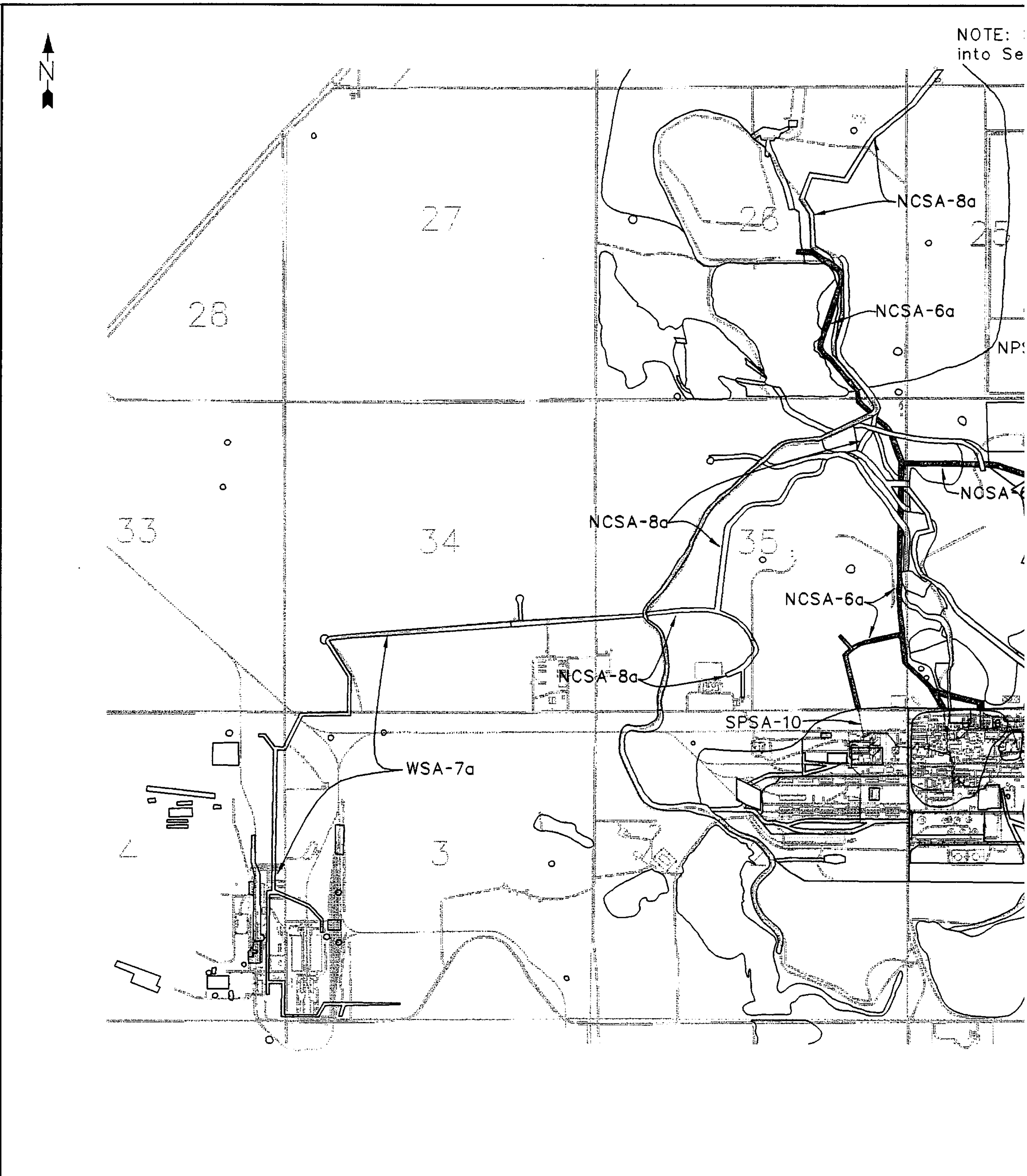
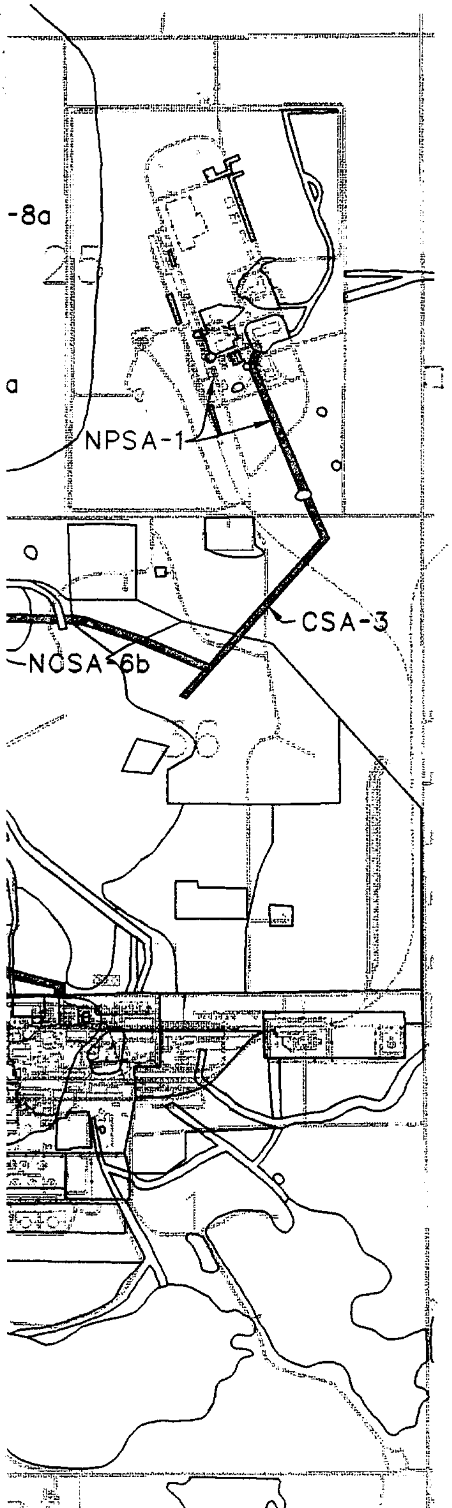
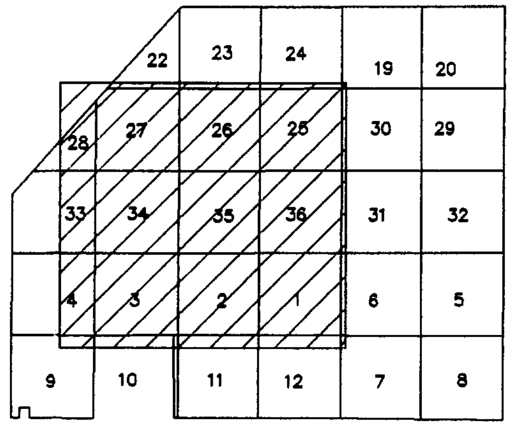


NOTE: Site NCSA 8a Continues Northeast into Section 24 to NCSA-8b



ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Principal Threat Exceedance Area

Human Health Exceedance Area

Site Boundary

Buildings and Roads

27 Section Number

NOTE: South Plants and North Plants Sewers Shown as Solid Lines

1000 0 1000 2000 FEET

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U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 13.4-1

Exceedance Areas
Chemical Sewers Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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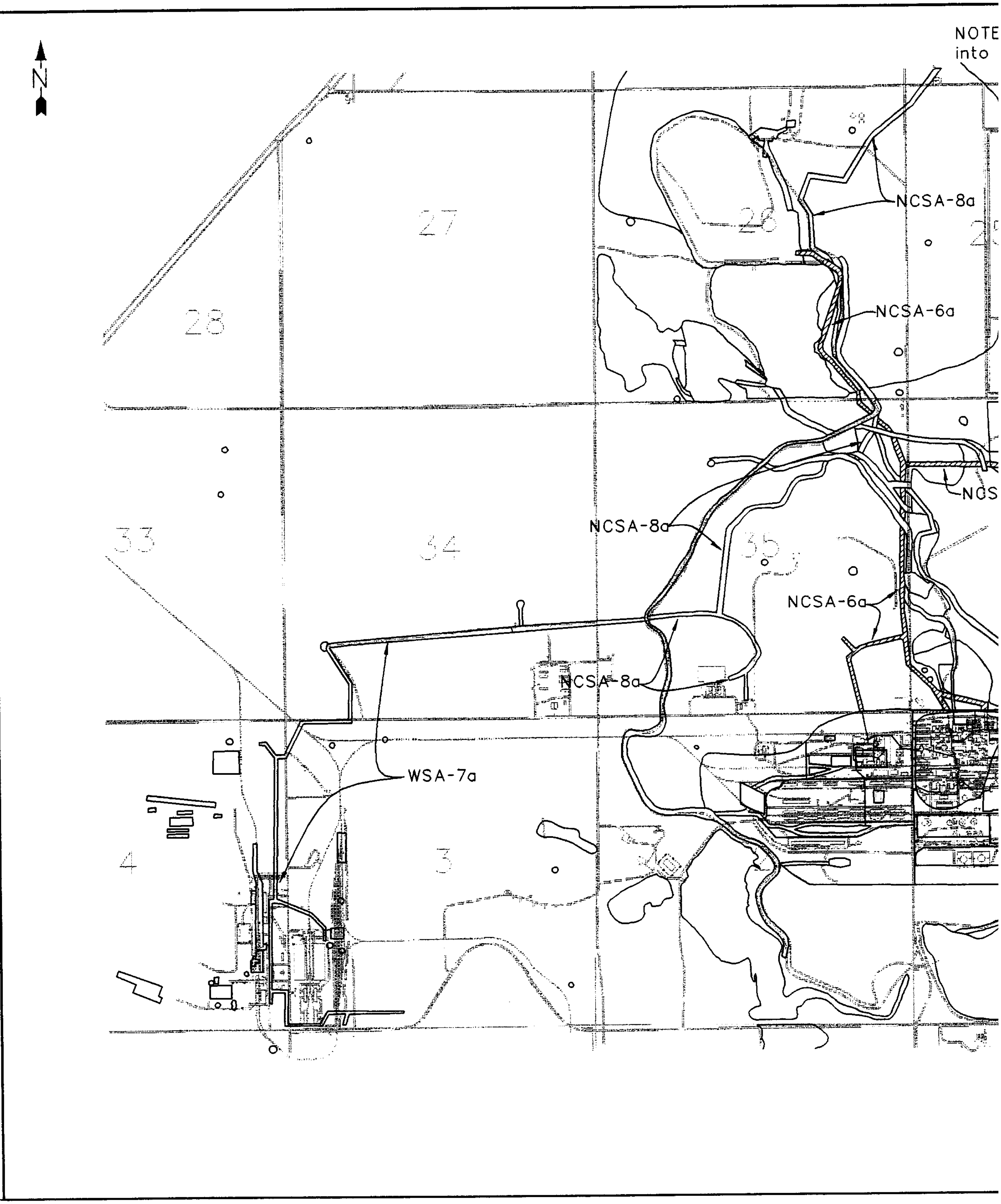
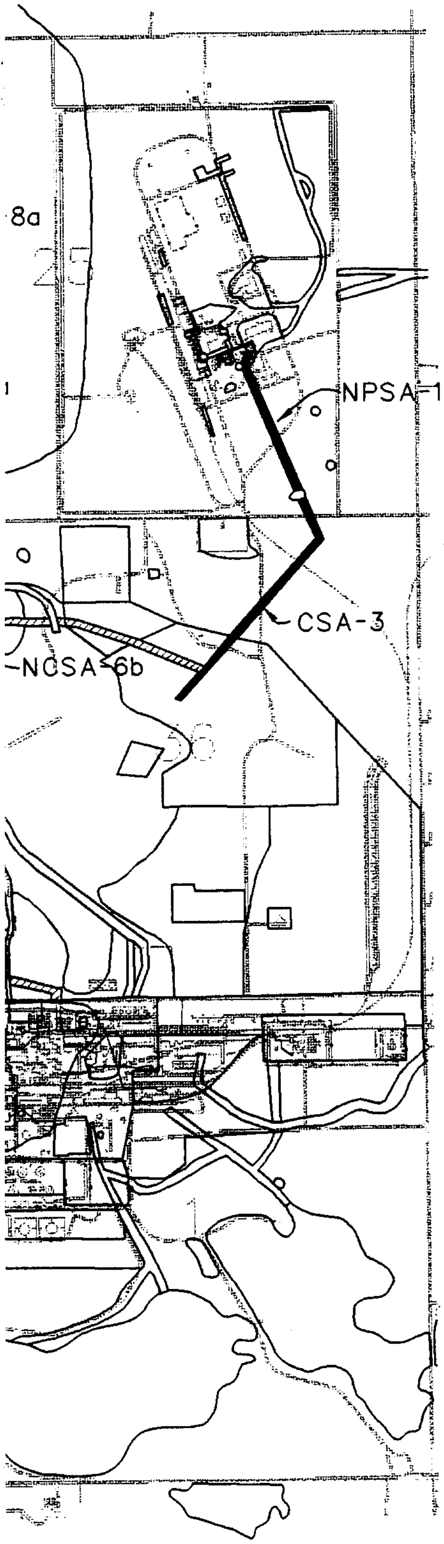
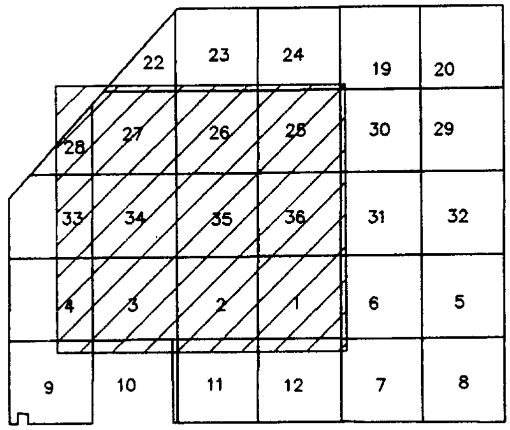


NOTE: Site NCSA-8a Continues Northeast into Section 24 to NCSA-8b



ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Human Health/Biota Exceedance Area

Potential Agent Presence Area

Site Boundary

Buildings and Roads

Section Number

NOTE: South Plants and North Plants Sewers Shown as Solid Lines

1000 0 1000 2000 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 13.4-2

Potential Agent Presence Area
Chemical Sewers Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

14.0 DETAILED ANALYSIS OF ALTERNATIVES FOR THE DISPOSAL TRENCHES MEDIUM GROUP

The Disposal Trenches Medium Group contains three exceedance sites (Figure 14.0-1). Disposal practices at these sites consisted of excavating open trenches or pits and filling them with trash and manufacturing/military wastes. The wastes are suspected to consist of drums of solid and liquid material, wood, glass, metal, laboratory and manufacturing equipment, and other miscellaneous material. Physical and chemical hazards are potentially present at these sites, including agent and UXO. The depth of contamination is variable, but generally less than 12 ft, and the contamination patterns are highly heterogeneous. The exceedance sites are separated by type and contamination pattern to form three subgroups—Complex Trenches, Shell Trenches, and Hex Pit—each of which contains one site.

The primary Human Health COCs present in this medium group are OCPs, although DBCP, HCCPD, mercury, and ICP metals are also present at concentrations well above the Human Health SEC. The entire volume of the disposal trenches in these sites are considered principal threats because of the high levels of OCPs and ICP metals encountered in samples from the trenches, because of the presence of containerized wastes, and because of known sources of groundwater contamination at sites within this medium group. Table 14.0-1 presents the characteristics of this medium group, including exceedance volumes and COCs, and Appendix A details the volume and area estimates for these subgroups.

In the DSA, alternatives were developed and screened based on the general characteristics of the medium group. In the DAA, however, the retained alternatives do not necessarily apply to each subgroup. The characteristics of the three subgroups—including contaminants and contaminant concentrations, site configuration, and depth of contamination—were evaluated to determine the subset of applicable alternatives for each subgroup from the range of alternatives retained in the DSA for the medium group. The three retained alternatives for the Disposal Trenches Medium Group were determined to be applicable to each of the three subgroups with no major modifications.

For each subgroup, the following sections present the characteristics of the subgroup, an evaluation of the retained alternatives against the DAA criteria listed in the NCP (EPA 1990), and the selection of a preferred alternative based on a comparative analysis of the alternative. The preferred alternatives are as follows:

- Complex Trenches: Alternatives 5b—Containment of disposal trenches as defined by geophysical anomalies with a clay/soil cap and slurry wall. Consolidation of biota and remaining human health exceedances areas outside the disposal trench anomalies as grading fill prior to containment. Agent screening and UXO clearance of consolidated soils only.

- Shell Trenches: Alternative 14—Excavation of site and treatment of soils and debris by rotary kiln incineration and disposal of treated materials in on-post landfill. Vapor enclosure required during excavation.

- Hex Pit: Alternative 14—Excavation of site and treatment of soils and debris by rotary kiln incineration. Disposal of treated materials in on-post landfill. Vapor enclosure required during excavation.

14.1 COMPLEX TRENCHES SUBGROUP CHARACTERISTICS

The Complex Trenches Subgroup consists of site CSA-1c (Complex Disposal Area North) (Figure 14.0-1). This site contains soils and debris that were disposed in a series of trenches. The trenches were investigated during the RI and were found to contain trash and manufacturing/military waste including scrap metal, brick, concrete and asphalt rubble, empty and full glass bottles, white phosphorous, containerized wastes, burned incendiary device casings, and UXO. The trench areas, outlined by geophysical investigations, include 120,000 SY of contaminated soils and debris and are considered a principal threat area for this subgroup (Figure 14.0-1). Table 14.1-1 contains a summary of the estimated area and depth of trench material for each trench area as well as a catalog of the materials identified during the RI investigation of these trenches. An estimated 440,000 BCY of trench materials defined by the geophysical anomalies are considered a principal threat volume based on the anticipated high levels of contamination and presence of containerized waste (Table 14.0-1). Table 14.1-2 presents the range of concentrations within the disposal trenches and in the biota exceedance areas surrounding the trenches and the frequency of detections is provided in Table 14.1-3. The

contaminants listed for the disposal trenches in the Complex Trenches Subgroup are based on the contaminants identified in the RI, but the concentrations are based on the maximum levels identified for any disposal trench due to the heterogeneous nature of contamination in the trenches.

Approximately 30,000 BCY of contaminated soils outside of the anomalous areas contain chlordane and mercury above the Human Health SEC. These three COCs were detected at depths ranging from 1 to 10 ft below ground surface, although most of the chlordane exceedances were within the 0- to 1-ft depth interval. Approximately 39,000 BCY of soils outside the trench areas contain Biota COCs: OCPs, mercury, and arsenic. These COCs were detected at depths ranging up to 10 ft below ground surface. Table 14.1-2 summarizes contaminants, concentrations, and exceedance values for this subgroup. The maximum concentration found in any trench area was assumed to apply to all of the areas.

Site CSA-1c has been identified as a source of two discrete groundwater contamination plumes. These plumes, the Section 36 Bedrock Ridge Plumes, occur in the unconfined bedrock aquifer in the northeast portion of the section, and appear to emanate from the burial sites and extend to the northeast. The plumes are separated from the Basin A groundwater drainage by a bedrock ridge. Groundwater alternatives for the Basin A Plume Group address mass reduction systems for individual plumes or improved performance of the existing Basin A Neck IRA system. Coordination of excavation and containment alternatives for soils developed for this subgroup is required with those developed for the Basin A Plume Group. In addition, if dewatering is required for excavation or long-term hydraulic control, coordination is necessary with alternatives developed for the Basin A Plume Group in order to determine which treatment system should be used for the groundwater removed during dewatering.

The Complex Trenches Subgroup is considered to exhibit poor-quality habitat based on the vegetation type encountered at the site. The areas disturbed during remediation are revegetated with native grasses in accordance with a refuge management plan. As such, the overall habitat

value is improved through remedial actions. However, burrowing animals are excluded from these areas for alternatives involving containment with a cap/cover.

14.2 COMPLEX TRENCHES SUBGROUP EVALUATION OF ALTERNATIVES

The alternatives for the Complex Trenches Subgroup vary in approach from no action to containment and treatment. The alternatives retained in the DSA for this subgroup were not modified except for the consolidation of exceedances outside of the trench areas as part of the containment alternative. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedances (which is listed first), areas of biota exceedances located outside the disposal trenches (the "B" alternatives), and areas of potential agent (the "A" alternatives) or UXO (the "U" alternatives) presence.

14.2.1 Alternative 1/B1/A1/U1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), Alternative A1: No Additional Action (Provisions of FFA), and Alternative U1: No Additional Action (Provisions of FFA), applies to all 350,000 SY of exceedance area and 510,000 BCY of exceedance volume in the Complex Trenches Subgroup. No action is taken to reduce human or biota exposure to COCs or to UXO or to reduce the potential for continued groundwater contamination from this site. The human health and biota exceedance areas outside of the disposal trenches are monitored (an average of 42 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants within these areas.

Table 14.2-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved and impacts on groundwater quality continue under this alternative as untreated soils remain in place without controls being initiated. The residual risk is high due to high levels of contamination and the potential presence of agent

and UXO. The poor-quality habitat at the site is not changed. The total estimated present worth cost of this alternative is $2,600,000. Table B4.8-1 details the costing for this alternative.

14.2.2 Alternative 5b/B5a/A2 and A4/U2 and U4: Caps/Covers; Vertical Barriers with Consolidation

Alternative 5b: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Consolidation in conjunction with Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation, Alternative A2: Caps/Covers (Clay/Soil Cap), and Alternative U2: Caps/Covers (Clay/Soil Cap) address the containment of 510,000 BCY of contaminated soils with four individual clay/soil caps and slurry walls which comer a total area of 130,000-SY. The four clay/soil caps cover the following areas: Anomaly A, Anomalies B, C, and F; Anomaly H, and Anomaly G. Any agent or UXO identified in the consolidated exceedance soils is addressed by Alternative A4: Incineration/Pyrolysis (Rotary Kiln) and Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration).

A soil/bentonite slurry wall, as described in Section 4.6.8 of the Technology Description Volume, is installed into competent bedrock (up to 28 feet below grade) around the perimeter of each trench area (8,700 LF total) to create four individual isolation cells. Fill materials for the slurry wall mix are excavated from an on-post borrow area. The soils excavated for the slurry wall trench are potentially contaminated and are graded over the surface of the isolation cell to be included under the cap. A dewatering system creates a reduced hydraulic head within the cell, minimizing the potential for further contamination via groundwater. Groundwater is removed from the cell at 0.2 gpm and pumped to the CERCLA Wastewater Treatment Plant.

The 70,000 BCY of human health and biota exceedance soils from the perimeter of the trench areas are excavated and consolidated within the isolation cell for containment. Odor controls, consisting of placing a temporary soil cover or plastic liner over the excavated areas, are initiated during the consolidation of these soils.

The consolidated soils potentially contain 1,000 BCY of agent and 1,000 BCY of UXO. Prior to excavation, the soils to be consolidated are cleared using geophysical surveys and a surface sweep with a metal detector is conducted to ensure that UXO are not present in near surface soils. Identified UXO is excavated, packaged, and transported off post for demilitarization at existing Army facilities. The 17,000 BCY of metallic debris mixed with soils from cleared UXO consolidated areas is placed into the on-post hazardous waste landfill.

During excavation of UXO and soils for consolidation, agent screening is conducted using real-time field analytical equipment. Soils with positive screening results are stockpiled and covered. If agent presence is confirmed by soil analysis from the RMA laboratory, the contaminated soils are incinerated. (Section 4.6 discusses incineration in detail.) The incinerator operates at 760°C with a 470 BCY/day processing rate and a 66-minute residence time. (Section 4.6.26 discusses emissions control for off gases from incineration.) Approximately 1 percent of the feed is entrained in the off-gas stream. These particulates are recovered in the scrubber blowdown and placed in the hazardous waste landfill.

Following slurry wall installation, agent screening, and UXO clearance, the consolidated soils and the disposal trench areas are contained with a 130,000-SY clay/soil cap. (Section 4.6 discusses clay/soil caps in detail.) The subgrade is regraded and compacted before any cover materials are installed to minimize topographic irregularities in the subgrade. The surface is crowned and graded to allow for surface-water drainage. The area is then covered by a 2-ft layer of low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. Most of the fill materials for the cap and slurry wall mix are excavated from an on-post borrow area. Six inches of topsoil is obtained off post and placed over 350,000 SY of disturbed area (including the 130,000-SY cap) that is then revegetated with native grasses. The borrow area is also recontoured and revegetated to restore habitat. Long-term maintenance activities ensure the continued integrity of the soil cover and operation of the dewatering system. Five-year site reviews are conducted to assess potential migration of contaminants and the integrity of the containment system.

Table 14.2-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs through containment and consolidation of human health and biota exceedance soils and through treatment of agent and UXO materials. The potential for migration of contaminants to groundwater is greatly reduced. The slurry wall, consolidation, and capping operations take 2 years to complete; however, 2 years are required to build the incinerator and 1 year is required concurrently for the construction of the landfill. Habitat is improved at the site, but biota are removed in the capped area. Long-term maintenance is required to ensure the integrity of the cap, dewatering system, and landfills. The total estimated present worth cost of this alternative is $29,000,000. Table B4.8-5b details the costing for this alternative.

14.2.3 Alternative 14/B6/A4/U4: Incineration/Pyrolysis; Landfill

Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill), along with Alternative B6: Direct Thermal Desorption (Direct Heating), treats 470,000 BCY of trench materials and contaminated soils exceeding Human Health SEC by rotary kiln incineration and 37,000 BCY with biota exceedances by thermal desorption. During excavation operations, areas with potential agent are addressed by Alternative A4: Incineration/Pyrolysis (Rotary Kiln) and areas with potential UXO by Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration).

Prior to excavation, the areas are cleared for UXO using geophysical surveys. An estimated 1,200 BCY of identified UXO are packaged and shipped to an off-post Army facility for demilitarization. Approximately 120,000 BCY of metallic debris mixed with soil from cleared areas are excavated and placed in the on-post hazardous waste landfill. During excavation, the biota exceedance volume is screened for the presence of agent with real-time field analytical methods. An estimated 1,200 BCY of soils confirmed to contain agent is treated by rotary kiln incineration. One percent of the solids feed (12 BCY) is recovered as particulates from scrubber blowdown and is landfilled. Operating characteristics of the incinerator are described below.

Trench materials are not screened for agent since they are treated by incineration, which destroys any agent that is present.

Volatile emissions and noxious odors are controlled during excavation by enclosing the disposal trench excavations with an air-supported vapor enclosure that includes a vapor treatment system. The structure is fabricated from a synthetic fabric coated to achieve zero porosity. The containment structures utilized during the excavation of the Complex Trenches are fabricated from aluminum structural members covered with a coated synthetic fabric. The structures can be erected on an even, level surface with no foundation, although large precast conctrete blocks will be used for ballast. A total of 20 structures will be utilized, and each structure will be round and approximately 150 ft in diameter. Each structure will be constructed to permit lifting and relocation of the structure as a single unit to a new excavation area or to allow in-place detonation of any UXO determined to be unsafe for transport without damaging the structure. An air pollution control system will draw air from the structure for treatment with a wet scrubber reducing the level of personal protective equipment required for safe working conditions within the structure. Because the air pollution control system will create a slight negative pressure within the structure, entry and exit doors can be opened for short periods of time without releasing contaminants or odors and thus eliminating the need for airlocks. The structure is supported by an internal pressure of 0.10 psig and designed to withstand wind velocities of 80 mph and a snow load of 4 feet. The alkaline aqueous solution from the wet scrubber system is treated through mixture with the acidic blowdown water from the thermal desorber for subsequent treatment at the CERCLA Wastewater Treatment Plant. In this manner, volatile emissions and odors are controlled and do not impact the community. However, extensive worker health and safety measures are required during excavation based on the high levels of contamination and the physical and acute chemical hazards present. Odor controls, consisting of a temporary soil cover or plastic liner over the excavated areas, are also initiated during the excavation of the soils outside the disposal trench areas. Dewatering is also required 2 years prior to and during excavation of soils near the water table, primarily near anomaly area H. The groundwater is removed at 2 gpm and pumped to the CERCLA Wastewater Treatment Plant.

After excavation, 470,000 BCY of soil and debris are treated by incineration. (Section 4.6.26 discusses the details of incineration.) A portion of the debris contained in these soils is very large (based on the identification of a buried forklift during the RI). All oversize debris is removed and landfilled prior to rotary kiln incineration. The disposal of the large debris requires sizing operations such as grinding and crushing, which increases the risk to site workers. The incinerator has a soils processing rate of 470 BCY/day, requires approximately 1 year to build, and requires an additional year for testing. The incinerator operates with a soils discharge temperature of 760°C and has a soils residence time of 66 minutes. (Section 4.6.26 describes emission controls for off gases from incineration). The treated soils and debris are transported from the incineration facility to the multiple cell hazardous waste landfill. (Section 4.6.5 presents details of the landfill). Although construction of the first cell only requires 1 year, this activity starts during year 2 to have the same completion date as that of the incinerator. The excavations are backfilled with 470,000 BCY of borrow material that is transported from the on-post borrow area. Approximately 350,000 SY of disturbed areas are covered with 6 inches of topsoil and are revegetated with native grasses. In addition, the borrow area is also recontoured and revegetated to restore habitat.

The 39,000 BCY of biota exceedance volume is treated by thermal desorption. (Section 4.6 discusses the details of thermal desorption.) The thermal desorber requires approximately 1 year to build and an additional year for testing. For the dry soils being processed, the thermal desorber operates with a soils discharge temperature of 300°C, has a residence time of 30 minutes, and processes soils at approximately 2,000 BCY/day. Approximately 1 percent of the total feed for both rotary kiln incineration and thermal desorption is entrained in the off-gas stream and recovered from the off-gas equipment. (Sections 4.6.24 and 4.6.26 discuss emission controls for these technologies.) Due to the mercury and arsenic content, 5,100 BCY (1 percent of the total soils feed) of particulates from the scrubber blowdown are placed in the on-post hazardous waste landfill. The treated soils are backfilled into the excavations following thermal desorption. Since thermal desorption destroys the natural organic content of the soils, a 6-inch layer of topsoil is installed over the treated areas and is revegetated with native grasses.

Table 14.2-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs since all contaminated soils are treated to remove or destroy the exceedance COCs. The habitat is improved at the site, and the contamination of groundwater is reduced through the removal of the disposal trenches. The incineration, thermal desorption, and landfilling of 510,000 BCY of soils requires 8 years; years 1 and 2, however, involve construction and testing of the facilities. Although this alternative is technically feasible, the difficulties encountered with the community over the operation of an incinerator may make the administrative feasibility of this alternative questionable. The physical and acute chemical hazards present in these trenches represent a substantial risk to site workers during excavation even though the workers use protective equipment. Furthermore, the potential exists for impacts on the community during excavation if the hazards encountered breach the vapor enclosure. The total estimated present worth cost of this alternative is $310,000,000. Table B4.8-14 details the costing for this alternative.

14.3 COMPLEX TRENCHES SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Complex Trenches Subgroup contains 510,000 BCY of exceedance volume resulting from disposal of soils and debris into a series of trenches. Areas of this subgroup outside of the trenches proper include human health exceedances of chlordane and mercury and biota exceedances of dieldrin, p,p,DDE, endrin, and arsenic. The trench materials are considered principal threat exceedances based on the anticipated high levels of contamination, the heterogenous nature of the materials, and the presence of containerized waste. This subgroup also potentially contains UXO and agent based on the site history and remedial investigations and has been identified as the source of two groundwater contamination plumes.

This subgroup has poor-quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration. No significant habitat impacts are anticipated, although burrowing animals are excluded for alternatives involving caps/covers.

There are high short-term worker and community risks associated with the excavation of this subgroup due to the high levels of contamination and the presence of UXO and agent. Site workers require extensive health and safety measures to protect against the physical and acute chemical hazards present. The adequacy of a vapor enclosure to control emissions and reduce community risk is not certain due to the potential for explosion from white phosphorous and UXO. These controls reduce the productivity of workers and substantially increase the cost and difficulty of the excavation operation.

In summary, the Complex Trenches Subgroup contains high levels of heterogenous contamination, including potential UXO and agent presence. The selection of the preferred alternative for this subgroup must balance the potential long-term risks of contaminant migration if the trench materials are left in place versus the high short-term risks to workers and the community from excavation operations.

Alternative 1: No Additional Action does not achieve RAOs and is eliminated from further consideration. The two remaining alternatives include a treatment and a containment alternative. Both alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action- and location-specific ARARs for the DAA.

Alternative 14: Incineration/Pyrolysis; Landfill achieves RAOs through excavation and treatment of the disposal trenches and surrounding contaminated soils. A vapor enclosure is required during excavation to control vapor emissions and protect the community and workers elsewhere at RMA; however, the adequacy of the vapor enclosure is not certain as these trenches contain explosive materials, including UXO and white phosphorous. The presence of these explosive materials, in combination with high levels of contamination and Army agent, results in a very high short-term risk to site workers even though protective equipment is used. In addition, Alternative 14: Incineration/Pyrolysis; Landfill requires the disposal of 120,000 BCY of highly contaminated debris with potential agent presence, some of which is very large (e.g., forklifts and

mixing vats) prior to rotary kiln incineration. Alternative 14: Incineration/Pyrolysis; Landfill has a significantly higher cost ($310,000,000) than the containment alternative ($29,000,000).

Alternative 5b: Caps/Covers; Vertical Barriers with Consolidation achieves RAOs through containment by interrupting exposure pathways and reducing the migration of contaminants to groundwater. This alternative requires the long-term operation of the dewatering system to maintain hydraulic controls and maintenance of a 130,000-SY clay/soil cap. The consolidation of 70,000 BCY of contaminated soils from outside the trench areas reduces the area that must be monitored in the long term. The excavation of soils in the vicinity of the trenches requires odor control measures to minimize any volatilization, but the consolidation of soils exhibits a much lower short-term risk than the excavation of the trenches themselves.

The preferred alternative for the Complex Trenches Subgroup is Alternative 5b: Caps/Covers; Vertical Barriers with Consolidation. This alternative exhibits much fewer short-term impacts since the soils and debris in the disposal trench are not excavated. This alternative does require long-term dewatering to ensure the inward migration of groundwater. The NCP (EPA 1990) indicates that principal threat areas can be addressed by engineering controls where treatment is inappropriate. EPA guidance on principal threat materials (EPA 1991b) indicates that treatment alternatives for principal threats may not be appropriate in instances for which the implementation of the treatment-based alternative results in a greater overall risk to human health and the environment due to the risks posed to site workers and the community during the remedial action as compared to an alternative including engineering controls. The installation of a clay/soil cap and a slurry wall interrupts exposure pathways and reduces groundwater contamination, while the excavation of the disposal trenches for treatment by rotary kiln incineration results in a greater risk to workers and the community. As indicated in the referenced guidance and the preamble to the NCP (EPA 1990), the selection of Alternative 5b: Caps/Covers; Vertical Barriers with Consolidation for the Complex Trenches Subgroup is an appropriate exception to the guidance regarding the treatment of principal threats.

As part of the containment of the Complex Trenches Subgroup, long-term dewatering is required to ensure the inward migration of groundwater. This dewatering affects the selected alternative for the Basin A Plume Group, Alternative AC-3/AT-2, which involves mass reduction and the continued operation of the Basin A Neck IRA. Thus, the design of the long-term hydraulic controls associated with the slurry walls must be coordinated with the well locations for Alternative AC-3/AT-2.

14.4 SHELL TRENCHES SUBGROUP CHARACTERISTICS

The Shell Trenches Subgroup is composed of site CSA-1a (Pesticide Pits) (Figure 14.0-1). This site contains approximately 18 trenches that were filled with a variety of solid and liquid wastes from Shell production facilities. Disposal operations occurred from 1952 through 1966, and the wastes were buried both in bulk form and in drums. The entire 100,000 BCY of contaminated soils at the site are considered a principal threat area because there are high levels of contamination present, because there are containerized wastes present, and because this subgroup is a known source of groundwater contamination. This subgroup has been contained as part of the Shell Trenches IRA. A vertical barrier was installed around the site to reduce the migration of contaminated groundwater away from the site and a soil cap was placed over the site to reduce the migration of contaminants to the groundwater. The soil cover is approximately 3 ft thick and has been revegetated.

The Shell Trenches Subgroup does not contain large areas of shallow contaminated soils surrounding the disposal trenches (also the Comples Trenches), so the site does not include an area that exceeds only Biota SEC or that does not exceed principal threat criteria. The disposal trenches themselves contain elevated levels of OCPs, HCCPD, and DBCP, which are encountered to a depth of 10 feet. In addition to the COCs identified in the trenches, numerous nontarget compounds, which are intermediates and byproducts from the manufacturing of pesticides, are identified at concentrations of up to 40,000 ppm. Table 14.4-1 summarizes contaminants, concentrations, and exceedance values for this subgroup and Table 14.4-2 provides the frequency of detections.

Site CSA-1a is identified as a source of groundwater contamination. The Basin A Plume occurs in the unconfined aquifer in Section 36 and emanates from the trench area and the Basin A liquid waste disposal area and extends to the northwest where it is intercepted and treated by the Basin A Neck IRA. The Shell Trenches IRA reduces the migration of contaminated groundwater away from the site and reduces the migration of contaminants from the trenches to groundwater. Groundwater alternatives that address improved performance for the Basin A Neck IRA treatment system or the addition of individual plume group remediation systems are being evaluated as part of the Basin A Plume Group. Coordination is required for excavation or containment alternatives developed for the Shell Trenches Subgroup with the Basin A Plume Group. The installation of hydraulic controls or use of dewatering is also to be coordinated with alternatives evaluated for the Basin A Plume Group.

The Shell Trenches Subgroup is considered to exhibit poor-quality habitat based on the vegetation type encountered at the site. The areas disturbed during remediation are to be revegetated with native grasses, so the overall habitat value is to be improved through remedial actions. However, those areas for alternatives involving containment with a cap/cover exclude burrowing animals from the site.

14.5 SHELL TRENCHES SUBGROUP EVALUATION OF ALTERNATIVES

The alternatives for the Shell Trenches Subgroup vary in approach from no action to treatment. The alternatives retained in the DSA for this subgroup were not modified except to use modifications to the existing containment system as part of the containment alternative. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA.

14.5.1 Alternative 1: No Additional Action

Alternative 1: No Additional Action applies to all 32,000 SY of exceedance area in the Shell Trenches Subgroup. The 100,000 BCY of principal threat volume remains in place. No actions beyond the existing vertical barrier and soil cap are taken to reduce human or biota exposure to

COCs or to reduce the potential for further groundwater contamination from this site. Five-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 14.5-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative is protective of human health due to the existing soil cover placed on the site. Biota RAOs are not achieved by the alternative since burrowing animals are not excluded, and long-term protection of groundwater is uncertain. High concentrations of untreated soils remain in place, but the residual risk is low due to the soil cap and vertical barrier. The poor-quality habitat at the site is not changed. The total estimated present worth cost for this alternative is $520,000. Table B4.9-1 details the costing for this alternative.

14.5.2 Alternative 5a: Caps/Covers; Vertical Barriers with Modifications to Existing System

Alternative 5a: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Modifications to Existing System addresses the containment of the 100,000 BCY of principal threat volume with a 32,000-SY clay/soil cap. The existing 6-inch slurry wall is modified to a thicknes of 3 feet with a soil/bentonite slurry wall. The soil/bentonite slurry wall is installed into competent bedrock (to approximately 26 feet below grade) around the perimeter of the site (2,300 LF) to form an isolation cell. (Section 4.6 presents details of clay/soil caps and slurry walls.) The soils excavated for the modified slurry wall trench are graded over the surface of the isolation cell and included under the cap because they are potentially contaminated. A dewatering system creates a reduced hydraulic gradient within the cell, minimizing the potential for further contaminant migration via groundwater. Groundwater removed from the cell is pumped at 0.5 gpm to the CERCLA Wastewater Treatment Plant.

Following slurry wall installation, a clay/soil cap is constructed over the existing clay cap. The subgrade is regraded and compacted before any cover materials are installed to minimize topographic irregularities in the subgrade. The area is covered by a 2-ft layer of low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of

topsoil. The uppermost 2 ft of the existing soil cover are removed, stockpiled, and incorporated into the soil/ vegetation layer. Most of the fill materials for the cap and slurry wall are excavated from an on-post borrow area. The 32,000 SY of principal threat volume are covered with 6 inches of topsoil obtained off post and are revegetated with native grasses. Burrowing animals are excluded by the biota barrier, preventing damage to the system. The borrow area is also recontoured and revegetated to restore habitat. The slurry wall and capping operations take 1 year to complete, and the maintenance activities ensure the upkeep of the soil cover and the dewatering system. Five-year site reviews are conducted to assess the potential migration of contaminants and the integrity of the containment system.

Table 14.5-2 presents the detailed evaluation of the alternative against the EPA criteria for the DAA. This leaching achieves Human Health RAOs through modification of the containment system. The mobility of contaminants to groundwater is greatly reduced, and the exposure pathways are interrupted. Habitat is improved at the site, but biota are removed from the capped area. Long-term maintenance is required to ensure the integrity of the cap and dewatering system. The total estimated present worth cost of this alternative is $6,600,000. Table B4.9-5a details the costing of this alternative.

14.5.3 Alternative 14: Incineration/Pyrolysis; Landfill

Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) treats 100,000 BCY of trench materials by rotary kiln incineration and landfilling. (Section 4.6 discusses details of these technologies.) Volatile emissions and noxious odors are controlled during excavation by enclosing the trenches with an air-supported vapor enclosure. A vapor control system is included in this enclosure to prevent impacts on the community. The containment structures utilized during the excavation of the Complex Trenches are fabricated from aluminum structural members covered with a coated synthetic fabric. The structures can be erected on an even, level surface with no foundation, although large precast conctrete blocks will be used for ballast. A total of 20 structures will be utilized, and each structure will be round and approximately 150 ft in diameter. Each structure will be constructed to permit lifting and relocation of the structure

as a single unit to a new excavation area or to allow in-place detonation of any UXO determined to be unsafe for transport without damaging the structure. An air pollution control system will draw air from the structure for treatment with a wet scrubber reducing the level of personal protective equipment required for safe working conditions within the structure. Because the air pollution control system will create a slight negative pressure within the structure, entry and exit doors can be opened for short periods of time without releasing contaminants or odors and thus eliminating the need for airlocks. The structure is fabricated from a synthetic fabric coated to achieve zero porosity. The structure is supported by an internal pressure of 0.10 psig and designed to withstand wind velocities of 80 mph and a snow load of 4 feet. The alkaline aqueous solution from the wet scrubber system is treated through mixture with the acidic blowdown water from the thermal desorber for subsequent treatment at the CERCLA Wastewater Treatment Plant. Dewatering is required for 2 years prior to and during the excavation of the soils. The groundwater is removed at 3 gpm and also pumped to the CERCLA Wastewater Treatment Plant.

The IRA soil cover (31,000 SY) is excavated and stockpiled nearby as overburden prior to excavation of the trenches. The 100,000 BCY of exceedance volume is then excavated and transported to the on-post incinerator. The incinerator has a soils processing rate of 470 BCY/day, and requires approximately 1 year to build and an additional year for testing. The incinerator operates with a soil discharge temperature of 760°C and has a soils residence time of 66 minutes for dry soils. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the total soils feed (1,000 BCY) is recovered as particulates from scrubber blowdown and is placed in the on-post landfill. The treated soils are transported from the incineration facility to the hazardous waste landfill. The landfill is a multiple cell facility that requires 1 year for construction of the first cell and associated facilities. The construction of the cell starts during year 2 to have the same completion date as the incinerator.

The 100,000 BCY of borrow material is transported from the on-post borrow area to backfill the site excavations. The stockpiled overburden is used to cover the backfill, and the site is revegetated with native grasses to improve habitat quality. The borrow area is also regraded and revegetated to restore habitat.

Table 14.5-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs since all contaminated soils are treated to remove or destroy the exceedance COCs. The potential migration of contaminants to groundwater is reduced through treatment, and the habitat is improved at the site following remediation. Although this alternative is technically feasible, the difficulties encountered with the community over the operation of an incinerator may make the administrative feasibility of this alternative questionable. The incineration and landfilling of 100,000 BCY of soils requires 3 years; years 1 and 2, however, involve construction and testing of the facilities. The total estimated present worth cost of this alternative is $70,000,000. Table B4.9-14 details the costing of this alternative.

14.6 SHELL TRENCHES SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Shell Trenches subgroup contains 100,000 BCY of soils that are considered a principal threat exceedance due to the high levels of contamination, the presence of containerized waste, and the groundwater contamination associated with the site. The contamination in the trenches is highly heterogenous as the disposal trenches were filled with a variety of solid and liquid wastes from Shell production facilities. Investigations show elevated levels of OCPs, HCCPD, and DBCP (Table 14.4-1). UXO and agent are not expected to be found at this site.

The Shell Trenches IRA involved installing a soil cap over the site and a vertical barrier around it. This reduces the migration of contaminants from the trenches to groundwater and the migration of contaminated groundwater away from the site. The cap also reduces human and biota exposure pathways to contaminated soils.

This subgroup has poor-quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration of habitat after remediation. No significant habitat impacts are anticipated, although those alternatives that involve containment with a cap/cover exlude burrowing animals for the site.

Excavation of the trenches in this subgroup requires extensive health and safety measures to protect workers. Excavation is conducted under a vapor enclosure to prevent any community exposure. These measures decrease worker productivity and increase the cost and difficulty of the excavation operations.

In summary, the Shell Trenches Subgroup contains high level contamination that is heterogeneously distributed within the trenches. The soil cover and vertical barrier installed during the IRA reduces the migration of contaminants to groundwater. In selecting the preferred alternative for this subgroup, the short-term risks to workers and the community of excavation must be balanced against the longer-term risks of potential contaminant migration if the trench materials are left in place and the IRA provides insufficient containment.

Alternative 1: No Additional Action is protective of human health due to the presence of the IRA cap, but does not achieve Biota RAOs or completely protect groundwater over the long term. Therefore, this alternative is eliminated from further consideration. The two remaining alternatives include a containment and a treatment alternative. Both alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action- and location-specific ARARs for the DAA.

Alternative 14: Incineration/Pyrolysis; Landfill achieves RAOs through treatment of the trench materials. Although this alternative requires extensive worker health and safety measures and excavation under a vapor enclosure, the potential short-term impacts of excavating the disposal trenches can be safely addressed since explosive materials were not placed in these trenches. This alternative exhibits a substantially higher cost ($70,000,000) than Alternative 5a:

Caps/Covers; Vertical Barriers with Modifications to Existing System ($6,600,000). Alternative 5a: Caps/Covers; Vertical Barriers with Modifications to Existing System achieves RAOs by interrupting exposure pathways and reducing groundwater contamination, but does not achieve the guidelines provided in the NCP (EPA 1990) for the treatment of principal threats unless otherwise unpracticable. This alternative also entails long-term operation of the dewatering system and maintenance of the enhanced clay/soil cap.

The preferred alternative for the Shell Trenches Subgroup is Alternative 14: Incineration/Pyrolysis; Landfill. Although this alternative has a higher cost than the containment alternative, the selection of rotary kiln incineration is consistent with the NCP (EPA 1990) regarding the treatment of higher levels of contamination and principal threat areas. EPA guidance on principal threats (EPA 1991b) indicates that treatment alternatives for principal threats may not be appropriate for cases where the implementation of the treatment-based alternative would result in a greater overall risk to human health and the environment due to the risks posed to site workers and the community during the remedial action, as compared to engineering controls. However, although the modification to the clay/soil cap and a vertical barrier results in significantly lower short-term risks to workers and the community, the short-term risks posed by the excavation of the disposal trenches for treatment by rotary kiln incineration are adequately addressed by worker safety controls and a vapor enclosure. Therefore, the selection of Alternative 14: Incineration/Pyrolysis; Landfill is consistent with the guidance provided in the NCP and the referenced guidance document.

As part of the rotary kiln incineration of exceedance volumes in this subgroup, dewatering is required to allow the excavation of soils and debris from near the water table. Thus, coordination with the preferred alternative for the Basin A Plume Group, Alternative AC-3/AT-2, which involves mass reduction and continued operation of the Basin A Neck IRA, is required as the groundwater alternative, depending on the schedule for groundwater remediation, may reduce the need for a soils dewatering system.

14.7 HEX PIT SUBGROUP CHARACTERISTICS

The Hex Pit Subgroup is composed of site SPSA-1f (Buried Hex Pit) (Figure 14.0-1). The Hex Pit was historically used for disposal of residual materials (hex bottoms) resulting from the production of HCCPD. This material was buried in thin-gauge barrels and in bulk. The site is currently overlain by Building 571B. Assuming a depth of 10 ft, the site is estimated to contain approximately 3,300 BCY of trench materials. (Appendix A summarizes volume and area calculations.) The entire exceedance volume is considered a principal threat based on the presence of containerized waste and high levels of contamination (Table 14.0-1). Table 14.7-1 provides a summary of contaminants, concentrations, and exceedance criteria for the Hex Pit Subgroup and Table 14.7-2 summarizes the frequency of detections. The levels of HCCPD (40,000 ppm) are expected to be similar to those encountered in the Shell Trenches Subgroup. The site has not been classified as an identifiable source of groundwater contamination within the South Plants Central Processing Area, although potential migration pathways for the contamination of groundwater exist.

Since the site is currently overlain by structures within South Plants, the soils alternatives for the Hex Pit Subgroup must be coordinated with the selection of alternatives developed for the structures medium. The containment of the site requires the demolition of structures, but the resulting debris could be contained along with the disposal pit/trench. The consideration of a direct treatment alternative for this subgroup entails the demolition and removal of Building 571B and any associated structures.

The Hex Pit Subgroup is considered to exhibit poor-quality habitat based on the vegetation type encountered at the site. The areas disturbed during remediation are revegetated with native grasses, so overall the habitat value is improved through remedial actions. However, burrowing animals are excluded from these areas for alternatives involving containment with a cap/cover.

14.8 HEX PIT SUBGROUP EVALUATION OF ALTERNATIVES

The three alternatives developed for the Hex Pit Subgroup vary in approach from no action to containment and treatment. The alternatives retained in the DSA for this subgroup were not modified. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA.

14.8.1 Alternative 1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA) applies to the 3,300 BCY of principal threat volume in the Hex Pit Subgroup. This material remains in place, and no actions are taken to reduce human or biota exposure to COCs or to reduce any potential for groundwater contamination from this site. Five-year site reviews are conducted to assess potential migration of contaminants.

Table 14.8-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative does not achieve Human Health or Biota RAOs and does not reduce the potential for groundwater contamination as untreated soils remain in place without controls being initiated. The residual risk is moderate as the relatively high concentrations in soils are not present at the surface. The poor-quality habitat at the site is not changed. The no action alternative does not impact alternatives developed for the structures medium, which range from no action to demolition and removal. The total estimated present worth cost for this alternative is $180,000. Table B4.10-1 details the costing for this alternative.

14.8.2 Alternative 5: Caps/Covers; Vertical Barriers

Alternative 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) addresses the containment of 3,300 BCY of principal threat area with a 1,000 SY-clay/soil cap. (Section 4.6 discusses clay/soil caps and slurry walls in detail.) A soil/bentonite slurry wall is installed into competent bedrock (to approximately 33 feet below grade) around the perimeter of the site (380 LF) to form an isolation cell. The soils excavated for the slurry wall trench are potentially contaminated and are graded over the surface of the isolation cell and included under the cap.

Though not required based on present groundwater elevations, a dewatering system is installed as a contingency. Any groundwater recovered from the cell is pumped to the CERCLA Wastewater Treatment Plant. Depending on the pumping rate and the contaminant concentrations, pre-treatment may be required or the water may be sent off post for treatment.

Following slurry wall installation, the clay/soil cap is constructed. The subgrade is regraded and compacted before any cover materials are installed to minimize topographic irregularities in the subgrade. The surface is crowned with slurry wall excavation soils or borrow materials from the on-post borrow area to provide adequate surface-water runoff. The area is then covered by a 2-ft layer of low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. Most of the fill materials for cap and slurry wall are excavated from the on-post borrow area. Six inches of topsoil obtained off post is used to cover the area and the area is revegetated to restore habitat. Although the cap is revegetated, burrowing animals are excluded to prevent damage to the system. The borrow area is also recontoured and revegetated to restore habitat. This cap may be part of a larger cap covering the South Plants Central Processing Area (see Section 17.2). The slurry wall and capping operations take less than 1 year to complete. Long-term maintenance activities ensure the continued integrity of the soil cover and operation of the dewatering system. Five-year site reviews are conducted to assess potential migration of contaminants and the integrity of the containment system.

Table 14.8-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs and through containment. The exposure pathways are reduced, and the potential for migration of contaminants to groundwater is greatly reduced. Prior to construction of the slurry wall and clay/soil cap, Building 571B is demolished. The debris can either be removed or capped in place with the contaminated soil. Habitat is improved at the site, but is restricted for burrowing animals. Long-term maintenance is required to ensure the integrity of the cap and dewatering system. The total estimated present worth cost of this alternative is $2,000,000. Table B4.10-5 details the costing for this alternative.

14.8.3 Alternative 14: Incineration/Pyrolysis; Landfill

Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) treats 3,300 BCY of trench materials by rotary kiln incineration and landfilling. (Section 4.6 discusses the details of these technologies.)

Volatile emissions and noxious odors are controlled during excavation by enclosing the Hex Pit within an air-supported vapor enclosure. The enclosure is fabricated from a synthetic fabric coated to achieve zero porosity. The containment structures utilized during the excavation of the Complex Trenches are fabricated from aluminum structural members covered with a coated synthetic fabric. The structures can be erected on an even, level surface with no foundation, although large precast concrete blocks will be used for ballast. A total of 20 structures will be utilized and each structure will be round and approximately 150 ft in diameter. Each structure will be constructed to permit lifting and relocation of the structure as a single unit to a new excavation area or to allow in-place detonation of any UXO determined to be unsafe for transport without damaging the structure. An air pollution control system will draw air from the structure for treatment with a wet scrubber reducing the level of personal protective equipment required for safe working conditions within the structure. Because the air pollution control system will create a slight negative pressure within the structure, entry and exit doors can be opened for short periods of time without releasing contaminants or odors and thus eliminating the need for airlocks. The structure is supported by an internal pressure of 0.10 psig and designed to withstand wind velocities of 80 mph and a snow load of 4 feet. The aqueous solution from the wet scrubber system is basic and is treated through mixture with the acidic blowdown water from the thermal desorber for subsequent treatment at the CERCLA Wastewater Treatment Plant. Dewatering for excavation is not required based on the anticipated decrease in groundwater levels once man-made recharge sources (i.e., leaking water lines) are removed.

The 3,300 BCY of principal threat volume is excavated and transported to the on-post incinerator. The incinerator has a soils processing rate of 470 BCY/day, and takes approximately 1 year to build and an additional year for testing. The incinerator operates with a soil discharge

temperature of 760°C and has a soils residence time of 66 minutes for dry soils. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the total soils feed (33 BCY) is recovered as particulates from scrubber blowdown and is placed in the on-post landfill. The treated soils are transported from the incineration facility to the hazardous waste landfill. The multiple-cell landfill takes 1 year to build, which includes the associated facilities. The construction starts during year 2 to have the same completion date as the incinerator. The 3,300 BCY of borrow material is transported from the on-post borrow area to backfill the site excavations. The 1,000 SY of backfilled area is revegetated with native grasses to improve the habitat. This area may be covered as part of a cap for the South Plants Central Processing Area (see Section 17.2).

Table 14.8-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs since all contaminated soils are treated to remove or destroy the exceedance COCs. The potential migration of contaminants to groundwater is reduced through treatment, and the habitat is improved at the site. Prior to excavation of the soil, Building 571B is demolished and the resulting debris removed. Although this alternative is technically feasible, the difficulties encountered with the community over the operation of an incinerator may make the administrative feasibility of this alternative questionable. The incineration and landfilling of 3,300 BCY of soil requires less than 1 year, but the construction and testing of the facilities requires 2 years before the trench material soils are treated. The total estimated present worth cost of this alternative is $2,700,000. Table B4.10-14 details the costing for this alternative.

14.9 HEX PIT SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Hex Pit subgroup contains 3,300 BCY of trench materials from the disposal of residual hex bottoms from HCCPD production. The entire volume is considered a principal threat exceedance based on the presence of containerized waste and high levels of contamination (Table 14.7-1) Exceedance contaminants include OCPs, HCCPD, and DDT. Potential migration pathways exist for contamination of groundwater. UXO and agent are not expected to occur at this site.

The hex pit site is currently overlain by structures, so the site has poor-quality habitat. Disturbed areas are revegetated following remediation, so no significant environmental impacts are anticipated. Burrowing animals are excluded from the site for alternatives involving containment with a cap/cover.

The risk associated with direct exposure pathways to soils is moderate as the relatively high concentrations are not at the surface, and there is potential for migration of contamination to groundwater. Excavation of the trenches in this subgroup requires extensive health and safety measures due to the high concentrations and the heterogenous nature of trench materials. Excavation is conducted under a vapor enclosure to control community exposure to volatile emissions and noxious odors. These measures decrease worker productivity and increase the cost and difficulty of the excavation operations.

In summary, the Hex Pit Subgroup contains high levels of contamination. Selection of the preferred alternative for this subgroup must weigh the short-term risks to workers and the community of excavation against the longer-term risks of contaminant migration if trench materials are left in place.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs as untreated soils and debris remain on site without controls being implemented. As a result, this alternative is eliminated from further consideration as the preferred alternative. The two remaining alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action- and location-specific ARARs for the DAA. Alternative 14: Incineration/Pyrolysis; Landfill achieves RAOs through treatment of the trench materials. Although this alternative requires extensive worker health and safety measures and a vapor enclosure, the short-term impacts of excavating the disposal trenches can be adequately addressed. This alternative has a higher cost ($2,700,000) than Alternative 5: Caps/Covers; Vertical Barriers ($2,000,000).

Alternative 5: Caps/Covers; Vertical Barriers achieves RAOs by interrupting exposure pathways and reducing groundwater contamination, but does not achieve the guidelines provided in the NCP (EPA 1990) for the treatment of principal threats "unless otherwise unpracticable." This alternative also entails long-term operation of the dewatering system and maintenance of the enhanced clay/soil cap.

The preferred alternative for the Hex Pit Subgroup is Alternative 14: Incineration/Pyrolysis; Landfill. Although this alternative has a higher cost than the containment alternative, the selection of rotary kiln incineration is consistent with the NCP (EPA 1990) regarding the treatment of higher levels of contamination and principal threat areas. EPA guidance on principal threats (EPA 1991b) indicates that treatment alternatives for principal threats may not be appropriate for cases where the implementation of the treatment-based alternative would result in a greater overall risk to human health and the environment due to the risks posed to site worker and the community during the remedial action. However, although the installation of the clay/soil cap and slurry wall results in lower short-term risks to worker and the community, the short-term risks posed by the excavation of the disposal trenches for treatment by rotary kiln incineration are adequately addressed by worker safety controls and a vapor enclosure. Therefore, the selection of Alternative 14: Incineration/Pyrolysis; Landfill is consistent with the guidance provided in the NCP and the referenced guidance document.

The selection of Alternative 14: Incineration/Pyrolysis; Landfill necessitates the demolition of Building 571B and associated structures and the removal of the debris. As discussed in the Structures DAA, structural debris can be placed in Basin A or the South Plants Central Processing Area as grading fill prior to containment of these areas. As discussed in Section 10.2, this disposal method is predicated on the selection of Alternative 6f for the Basin A Medium Group or Alternative 6a for the South Plants Central Processing Area Subgroup (see Section 17.2).

Table 14.0-1 Characteristics of the Disposal Trenches Medium Group

Characteristic	Complex Trenches Subgroup	Shell Trenches Subgroup	Hex Pit Subgroup
Contaminants of Concern			
Human Health	OCPs, DBCP, ICP metals, Hg	OCPs, DBCP, HCCPD	OCPs, HCCPD[2]
Biota	OCPs, As, Hg	OCPs[1]	OCPs[1]
Exceedance Areas (SY)			
Total	350,000	31,000	1,000
Human Health	190,000	31,000	1,000
Biota	160,000	0	0
Potential Agent	370,000	0	0
Potential UXO	370,000	0	0
Exceedance Volume (BCY)			
Total	510,000	100,000	3,300
Human Health	470,000	100,000	3,300
Organic	470,000	100,000	3,300
Inorganic	460,000	0	3,300
Principal Threat	440,000	100,000	3,300

1 Biota contaminants of concern are only present as overlap within human health exceedance areas.
2 Assumed contaminant of concern based on historical information.

Table 14.0-1 Characteristics of the Disposal Trenches Medium Group

Characteristic	Complex Trenches Subgroup	Shell Trenches Subgroup	Hex Pit Subgroup
Biota	39,000	0	0
Potential Agent	1,300	0	0
Potential UXO	1,300	0	0
Depth of Contamination (ft)			
Human Health	0-14	0-10	0-10
Biota	0-10	0-10	0-10

1 Biota contaminants of concern are only present as overlap within human health exceedance areas.
2 Assumed contaminant of concern based on historical information.

Table 14.1-1 Summary of the Disposal Trench Materials for the Complex Disposal Trenches Subgroup

Trench Anomaly	Trench Anomaly Areas (SY)	Trench Depth Encountered (ft)	Trench Materials Encountered During RI Programs
A	28,000	10	Scrap metal including wire, steel straps, burned incendiary device casings, incendiary bomb parts and devices, HN sampling tubes, steel rebar, 30- and 55-gallon drums, ceramic containers, and 1/4-inch-diameter metal cable at 0.5 ft.
B	15,000	14	35- and 55-Gallon steel drums, fence posts, heavy piping, bomb casings, metal vats, baby bottles, metal debris, and small lab bottles.
C	25,000	10	Exploded bomb parts, 55-gallon steel drums, plastic igniter cups, piping with crusted white phosphorous residue, white phosphorous grenades, 55-gallon barrels, incendiaries, fuses, scrap iron, asbestos, scrap metal debris, rusted 55-gallon steel drums with dark-gray putty-like material that tested positive for Lewisite, reinforced concrete, metal bins, assembly-line rollers, barrels of 105-millimeter rounds, metal vats loaded with 500-pound bomb bursters, assembly-line roller tables, 55-gallon steel drums filled with bomb parts, 6,000-pound battery-powered forklift, metal vats with bomb bursters and scrap metal, and a 1-inch-diameter pipe. Excavation was backfilled when a large white phosphorous fire was started.
F	9,000	4	1/8-inch wire, burn residue, nose piece for mortar shell, and metal debris.
G	17,000	14	Trench materials assumed to be similar to other trench areas.
H	28,000	11	Metal rebar, bricks, concrete rubble, fibrous pipe insulation (asbestos), scrap metal, asphalt rubble, plastic caps, wire rebar, 55-gallon barrel lids, crystalline sulfur on surface of site, burned wood, charcoal, metal pipe, wire, cable, rubber hoses, black and gray sludge, wood, burned fuse casings, pipes, metal straps, bars, metal debris, amber and clear empty bottles, glass, clear glass vials, rock fragments, 4-inch-diameter metal pipes, scrap metal, full amber and clear glass bottles, light gray powdery material, full clear-glass vials, metal pipe, scrap metal, white phosphorous (9 ft) had to extinguish by burying, large broken concrete vats, burned incendiary device casings, firebricks, plastic, lumber, black tar-like substance, metal casing, pipe fragments, metal canister for flame throwers filled with black oily liquid, glass vials filled with clear liquid, lab bottles, burn material, positive test for mustard. Excavation was backfilled to extinguish white phosphorous fire.

SY square yard
ft feet

Ta[illegible]4.1-2 Summary of Concentrations for the Complex Tre[illegible] Subgroup

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–1,000	Not Available	56	560	0.68
Dieldrin	BCRL–500	Not Available	40	400	0.83
Endrin	BCRL–400	Not Available	15	15,000	0.029
Isodrin	BCRL–1,000	Not Available	3.4	3,400	not applicable
Chlordane	BCRL–70	Not Available	3.1	260	not applicable
DBCP	BCRL–700	Not Available	24	2,400	not applicable
Chromium	BCRL–5,200	Not Available	40	10,000	not applicable
Lead	BCRL–7,100	Not Available	1,900	Not Available	not applicable
Mercury	BCRL–680	Not Available	470	470,000	.99
p,p,DDT[1]	BCRL–1.9	Not Available	26	1,300	1.4
Arsenic[1]	BCRL–42	Not Available	530	5,300	16.5
Biota Exceedance Volume					
Aldrin	BCRL–40	Not Available	56	560	0.68
Dieldrin	BCRL–30	Not Available	40	400	0.83
Endrin	BCRL–1.6	Not Available	15	15,000	0.029
p,p,DDE	BCRL–3	Not Available	130	1,300	0.20
Arsenic	BCRL–110	Not Available	530	5,300	16.5
Mercury	BCRL–66	Not Available	470	470,000	0.99

1 Biota contaminant of concern is only present as overlap within human health exceedance areas.

Table 14.1-3 Frequency of Detections for Complex Trenches Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	302	290	96.0%	8	2.6%	3	1.0%	0	0.0%	1	0.3%
Benzene	72	72	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	72	72	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	292	268	91.8%	13	4.5%	--	--	11	3.8%	0	0.0%
Chloroacetic Acid	25	25	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	72	72	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	72	72	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	296	293	99.0%	1	0.3%	2	0.7%	0	0.0%	0	0.0%
p,p,DDT	296	291	98.3%	5	1.7%	0	0.0%	0	0.0%	0	0.0%
Dibromochloropropane	287	279	97.2%	8	2.8%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	72	72	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	2	2	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	285	285	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	302	267	88.4%	22	7.3%	12	4.0%	0	0.0%	1	0.3%
Endrin	302	288	95.4%	4	1.3%	10	3.3%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	297	295	99.3%	2	0.7%	--	--	0	0.0%	0	0.0%
Isodrin	302	299	99.0%	3	1.0%	--	--	0	0.0%	0	0.0%
Methylene Chloride	65	57	87.7%	8	12.3%	--	--	0	0.0%	0	0.0%
Tetrachloroethane	2	2	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	72	71	98.6%	1	1.4%	--	--	0	0.0%	0	0.0%
Toluene	72	72	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	72	69	95.8%	3	4.2%	--	--	0	0.0%	0	0.0%
Arsenic	300	212	70.7%	75	25.0%	11	3.7%	2	0.7%	0	0.0%
Cadmium	266	235	88.3%	31	11.7%	--	--	0	0.0%	0	0.0%
Chromium	266	55	20.7%	206	77.4%	--	--	5	1.9%	0	0.0%
Lead	266	206	77.4%	56	21.1%	--	--	4	1.5%	0	0.0%
Mercury	303	214	70.6%	80	26.4%	8	2.6%	1	0.3%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.
BCRL Below Certified Reporting Limit
HH SEC Human Health Site Evaluation Criteria
ppm parts per million
SEC Site Evaluation Criteria

Table 14.2-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions FFA); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the Complex Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs, as untreated soils remain if controls are not implemented; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Compiles with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Complex Trenches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) High residual risk. High levels of OCPs, DBCP, ICP metals, arsenic, and mercury above Human Health SEC remain in soil and may impact health human and biota; potential presence of agent/UXO remains.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated except by natural attenuation for soils outside disposal trenches; no reduction in contaminant volume or mobility; 510,000 BCY of untreated soils remain; no reduction in hazards for agent or UXO presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction for soils surrounding the disposal trenches; soils with potential agent and UXO remain untreated.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $2,600,000
d) Total	d) $2,600,000

Table 14.2-2 Evaluation of Alternative 5b: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative A2: Caps/Cover (Clay/Soil Cap) and Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U2: Caps/Covers (Clay/Soil Cap) and Alternative U4: Detonation (Off-post Army Facility); Incineration (Off-Post Incineration) for the Complex Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; disposal trenches contained by clay/soil cap, slurry wall and dewatering system, preventing exposure; remaining contaminated soils above Human Health and Biota SEC consolidated and contained groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, A-7, A-8, A-9, A-11, A-16, and A-17)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Complex Trenches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 510,000 BCY of untreated soils contained with 130,000 SY clay/soil cap, slurry wall, and dewatering system.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control, vegetative cover, slurry wall, and dewatering system require maintenance; high confidence in engineering controls of clay/soil cap and slurry wall.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 130,000-SY clay/soil cap, slurry wall, and dewatering system 70,000 BCY above Human Health and Biota SEC consolidated to reduce capped area; soils with agent/UXO identified and treated during consolidation.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap or slurry wall degrades or leaks.
d) Type and quantity of treatment residuals	d) Groundwater removed at 0.2 gpm by dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, excavation, and transportation of consolidated soils, and during installation of cap/cover and slurry wall and during dewatering.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil cover.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; burrowing animals excluded from area; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 4 years. Consolidation of 70,000 BCY feasible within 2 years after 2 years for construction of incinerator for agent treatment; containment of 130,000 SY feasible within 2 years.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; dewatering required; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover and slurry wall design and construction regulations.
c) Availability of services and materials	c) Readily available. Equipment and specialists readily available for clay/soil and slurry wall construction; several vendors available for dewatering system; clay/soil caps and slurry walls well documented at full scale.

Table 14.2-2 Evaluation of Alternative 5b: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative A2: Caps/Cover (Clay/Soil Cap) and Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U2: Caps/Covers (Clay/Soil Cap) and Alternative U4: Detonation (Off-post Army Facility); Incineration (Off-Post Incineration) for the Complex Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $2,100,000
b) Operating	b) $22,000,000
c) Long-term	c) $4,400,000
d) Total	d) $29,000,000

Table 14.2-3 Evaluation of Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Complex Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment and containment; contaminated soils treated to organic detection levels; treated soils and debris contained in on-post landfill, preventing exposure; blowdown solids placed in on-post landfill; groundwater reduced impacts.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-4, A-8, A-9, A-11, A-16, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Complex Trenches Subgroup, treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 470,000 BCY incinerated and placed in on-post landfill; oversized debris separated prior to treatment and landfilled; 39,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site, but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 470,000 BCY incinerated to degrade organics, remove mercury, and reduce arsenic and ICP metals and placed in on-post landfill; oversized debris separated prior to treatment and landfilled; 39,000 BCY thermally desorbed to degrade OCPs; soil with agent and UXO identified and treated.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Human Health and Biota SEC; arsenic reduced below Biota SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with mercury, arsenic, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by incineration and thermal desorption irreversible; mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) 5,100 BCY of blowdown solids with arsenic, mercury, and salts landfilled; groundwater pumped at 0.2 gpm by dewatering system pumped to CERCLA Wastewater Treatment PLant.

Table 14.2-3 Evaluation of Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Complex Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Extensive personnel protective equipment and vapor treatment system protect workers during agent/UXO clearance, dewatering, excavation, transportation, and treatment; physical and acute chemical hazards encountered during excavation represent large health and safety risk even though controls initiated.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by vapor enclosure with vapor treatment system; vapor emissions associated with incinerator and thermal desorber controlled by air emissions control equipment; physical and acute chemical hazards encountered during excavation represent large health and safety risk even though controls initiated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 8 years. Excavation and treatment of 470,000 BCY feasible within 6 years after 2 years for construction of incineration facility; treatment of 39,000 BCY feasible with 6 years after 2 years for construction of thermal desorption facility and landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; vapor enclosure required during excavation; dewatering required; additional remedial actions for landfilled soils and debris require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment facilities and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of incinerator, thermal desorber, dewatering system, and vapor enclosure; equipment, specialists, and materials readily available for construction of landfill; incinerators, thermal desorbers, and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $69,000,000
b) Operating	b) $240,000,000
d) Long-term	c) $1,600,000
c) Total	d) $310,000,000

Tab[illegible]4.4–1 Summary of Concentrations for the Shell Trenches [illegible]group

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–1,000	Not Available	56	560	0.68
Dieldrin	BCRL–500	Not Available	40	400	0.83
Endrin	BCRL–400	Not Available	15	15,000	0.029
Isodrin	BCRL–1,000	Not Available	3.4	3,400	not applicable
Chlordane	BCRL–70	Not Available	3.1	260	not applicable
DBCP	BCRL–700	Not Available	24	2,400	not applicable
HCCPD	BCRL–40,000	Not Available	1,300	Not Available	not applicable
p,p,DDT[1]	BCRL–1.9	Not Available	26	1,300	1.4

1 Biota contaminant of concern is only present as overlap within human health exceedance area.

Table 14.4-2 Frequency of Detections for Shell Trenches Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	78	45	57.7%	16	20.5%	9	11.5%	6	7.7%	2	2.6%
Benzene	43	35	81.4%	8	18.6%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	43	40	93.0%	3	7.0%	--	--	0	0.0%	0	0.0%
Chlordane	78	78	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroacetic Acid	10	10	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	43	42	97.7%	1	2.3%	--	--	0	0.0%	0	0.0%
Chloroform	43	26	60.5%	17	39.5%	--	--	0	0.0%	0	0.0%
p,p,DDE	78	73	93.6%	5	6.4%	0	0.0%	0	0.0%	0	0.0%
p,p,DDT	78	73	93.6%	5	6.4%	0	0.0%	0	0.0%	0	0.0%
Dibromochloropropane	78	57	73.1%	20	25.6%	--	--	0	0.0%	1	1.3%
1,2-Dichloroethane	43	42	97.7%	1	2.3%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	41	40	97.6%	1	2.4%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	78	69	88.5%	9	11.5%	--	--	0	0.0%	0	0.0%
Dieldrin	78	23	29.5%	21	26.9%	28	35.9%	6	7.7%	0	0.0%
Endrin	78	32	41.0%	13	16.7%	25	32.1%	8	10.3%	0	0.0%
Hexachlorocyclopentadiene	78	59	75.6%	16	20.5%	--	--	3	3.8%	0	0.0%
Isodrin	78	46	59.0%	23	29.5%	--	--	9	11.5%	0	0.0%
Methylene Chloride	43	29	67.4%	14	32.6%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	43	28	65.1%	15	34.9%	--	--	0	0.0%	0	0.0%
Toluene	43	27	62.8%	16	37.2%	--	--	0	0.0%	0	0.0%
Trichloroethylene	43	37	86.0%	6	14.0%	--	--	0	0.0%	0	0.0%
Arsenic	19	11	57.9%	8	42.1%	0	0.0%	0	0.0%	0	0.0%
Cadmium	16	9	56.3%	7	43.8%	--	--	0	0.0%	0	0.0%
Chromium	16	3	18.8%	13	81.3%	--	--	0	0.0%	0	0.0%
Lead	16	8	50.0%	8	50.0%	--	--	0	0.0%	0	0.0%
Mercury	74	53	71.6%	20	27.0%	1	1.4%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 14.5-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA) for the Shell Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Achieves RAOs based on existing soil cover but not Biota RAOs as untreated soils remain if additional controls are not implemented; groundwater impacts not reduced beyond protection provided by the existing IRA.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Shell Trenches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. High levels of OCPs, HCCPD, and DBCP above Human Health SEC remain in soils but existing containment system reduces human health exposure. b) No controls implemented. Site reviews and groundwater monitoring required.
b) Adequacy and reliability of controls	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
c) Habitat impacts	
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility beyond existing containment from IRA; 100,000 BCY of untreated soils remain but IRA cover and vertical barrier reduce human health exposure and groundwater migration pathways.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) RAOs not achieved for biota and groundwater protection.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth cost	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $520,000
d) Total	d) $520,000

Table 14.5-2 Evaluation of Alternative 5a: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Modifications to Existing System for the Shell Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained by clay/soil cap, slurry wall, and dewatering system, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, and A-7)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Shell Trenches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. Containment of 100,000 BCY of untreated soils augmented through installation of 32,000 SY clay/soil cap, slurry wall, and dewatering system.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover, slurry wall and dewatering system maintenance required; high confidence in engineering controls of clay/soil cap and slurry wall.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat; restrictions to burrowing animals helps preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through enhancement of 32,000 SY clay/soil cap and installation of slurry wall and dewatering system.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap or slurry wall degrades or leaks.
d) Type and quantity of treatment residuals	d) Groundwater removed at 0.5 gpm from dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of cap/cover, slurry wall, and during dewatering.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 1 year. Installation of 32,000-SY clay/soil cap, slurry wall, and dewatering system feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; dewatering required; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover and slurry wall design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, equipment, and specialists readily available for clay/soil cap, slurry wall construction, and dewatering system; several vendors available for dewatering system; clay/soil caps, slurry walls, and dewatering systems well demonstrated at full scale.

Table 14.5-2 Evaluation of Alternative 5a: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Modifications to Existing System for the Shell Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $370,000
b) Operating	b) $2,300,000
c) Long-term	c) $3,900,000
d) Total	d) $6,600,000

Table 14.5-3 Evaluation of Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) for the Shell Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment and containment; contaminated soils and debris treated to organic detection levels; treated soils and debris contained in on-post landfill, preventing exposure; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-4, A-8, and A-11)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Shell Trenches Subgroup, incinerator, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 100,000 BCY incinerated and placed in on-post landfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site, but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 100,000 BCY incinerated to degrade OCPs, DBCP, and HCCPD and placed in on-post landfill.
b) Degree and quantity of TMV reduction	b) Organics reduced to below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; scrubber blowdown solids from off-gas treatment equipment contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by incineration irreversible; mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) 1,000 BCY of blowdown solids landfilled; groundwater removed by dewatering at 3 gpm pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Extensive personnel protective equipment and vapor treatment system adequately protect workers during dewatering, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by vapor enclosure with vapor treatment system; vapor emissions associated with incinerator controlled by air emissions control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existingpoor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation, treatment, and landfilling of 100,000 BCY feasible within 1 year after 2 years for construction of incineration facility and landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; vapor enclosure required during excavation; dewatering required; additional remedial actions for landfilled soils and debris require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of incinerator and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of incinerator, dewatering system, and vapor enclosure; equipment, specialists, and materials readily available for construction of landfill; incinerators and landfills well demonstrated at full scale.

Table 14.5-3 Evaluation of Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) for the Shell Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $30,000,000
b) Operating	b) $40,000,000
c) Long-term	c) $380,000
d) Total	d) $70,000,000

Tal 4.7–1 Summary of Concentrations for the Hex Pit Subgr

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–1,000	Not Available	56	560	0.68
Dieldrin	BCRL–500	Not Available	40	400	0.83
Endrin	BCRL–400	Not Available	15	15,000	0.029
Isodrin	BCRL–1,000	Not Available	3.4	3,400	not applicable
Chlordane	BCRL–70	Not Available	3.1	260	not applicable
HCCPD	BCRL–40,000	Not Available	1,300	Not Available	not applicable
p,p,DDT[1]	BCRL–1.9	Not Available	26	1,300	1.4

1 Biota contaminants of concern are only present as overlap within human health exceedance area.

Table 14.7-2 Frequency of Detections for Hex Pit Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	1	0	0.0%	1	100.0%	0	0.0%	0	0.0%	0	0.0%
Chlordane	1	1	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	1	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
p,p,DDT	1	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Dibromochloropropane	1	1	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	1	1	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	1	0	0.0%	0	0.0%	1	100.0%	0	0.0%	0	0.0%
Endrin	1	0	0.0%	0	0.0%	1	100.0%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	1	0	0.0%	1	100.0%	--	--	0	0.0%	0	0.0%
Isodrin	1	0	0.0%	1	100.0%	--	--	0	0.0%	0	0.0%
Arsenic	1	1	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Cadmium	1	1	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chromium	1	1	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Lead	1	0	0.0%	1	100.0%	--	--	0	0.0%	0	0.0%
Mercury	1	0	0.0%	1	100.0%	0	0.0%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 14.8-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA) for the Hex Pit Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented; potential groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Hex Pit Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. High levels of OCPs and HCCPD above Human Health SEC remain in soil at depth.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility; 3,300 BCY of untreated soils remain.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) RAOs not achieved as untreated soils remain in place without adequate controls.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $180,000
d) Total	d) $180,000

Table 14.8-2 Evaluation of Alternative 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) for the Hex Pit Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health SEC contained by clay/soil cap, slurry wall, and dewatering system, preventing potential human and biota exposure; potential groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, and A-7)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Hex Pit Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions at FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 3,300 BCY of untreated soils contained through installation of 1,000-SY clay/soil cap, slurry wall, and dewatering system.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover, slurry wall, and dewatering system maintenance required; high confidence in engineering controls of clay/soil cap and slurry wall.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 1,000-SY clay/soil cap, slurry wall, and dewatering system.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap or slurry wall degrades or leaks.
d) Type and quantity of treatment residuals	d) Any groundwater removed by dewatering systems pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of cap/cover and slurry wall, and during dewatering.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; burrowing animals excluded from area; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 1 year. Installation of 1,000-SY clay/soil cap, slurry wall, and dewatering system feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; dewatering required; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume; demolition of structures required; structural debris can be consolidated as grading fill prior to capping.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover and slurry wall design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for clay/soil cap, slurry wall, and dewatering system construction; clay/soil caps, slurry walls, and dewatering well demonstrated at full scale.
7. Present worth cost	
a) Capital	a) $1,600,000
b) Operating	b) $210,000
c) Long-term	c) $190,000
d) Total	d) $2,000,000

Table 14.8-3 Evaluation of Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) for the Hex Pit Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment and containment; contaminated soils and debris treated to HCCPD and OCP detection levels; treated soils and debris contained in on-post landfill preventing exposure; blowdown solids placed in on-post landfill; potential groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-4, A-8, and A-11)	a) Complies with action-specific ARARs including state regulations on air emission sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Hex Pit Subgroup, incinerator, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions at FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 3,300 BCY incinerated and placed in on-post landfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site, but eliminates poor-quality habitat at landfill; area may be capped as part of remediation of South Plants Central Processing Area.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 3,300 BCY incinerated to degrade HCCPD and OCPs and placed in on-post landfill.
b) Degree and quantity of TMV reduction	b) Organics reduced to below detection levels (>99.99% destruction and removal effectiveness); TMV of organics eliminated; scrubber blowdown solids from off-gas treatment equipment contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by incineration irreversible; mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) 33 BCY of blowdown solids landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Extensive personnel protective equipment and vapor treatment system adequately protects workers during excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions and vapor treatment system controlled by vapor enclosure with vapor treatment system; vapor emission associated with incinerator controlled by air emissions control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation, treatment, and landfilling of 3,300 BCY feasible within 1 year after 2 years for construction of incineration facility and landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; vapor enclosure required during excavation; additional remedial actions for landfilled soils and debris require removal of landfill cover; demolition and removal of structures required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of incinerator and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of incinerator, dewatering system, and vapor enclosure; equipment, specialists, and materials readily available for construction of landfill; incinerators and landfills well demonstrated at full scale.

Table 14.8-3 Evaluation of Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) for the Hex Pit Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $1,300,000
b) Operating	b) $1,300,000
c) Long-term	c) $13,000
d) Total	d) $2,700,000

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DATE 3/2/93

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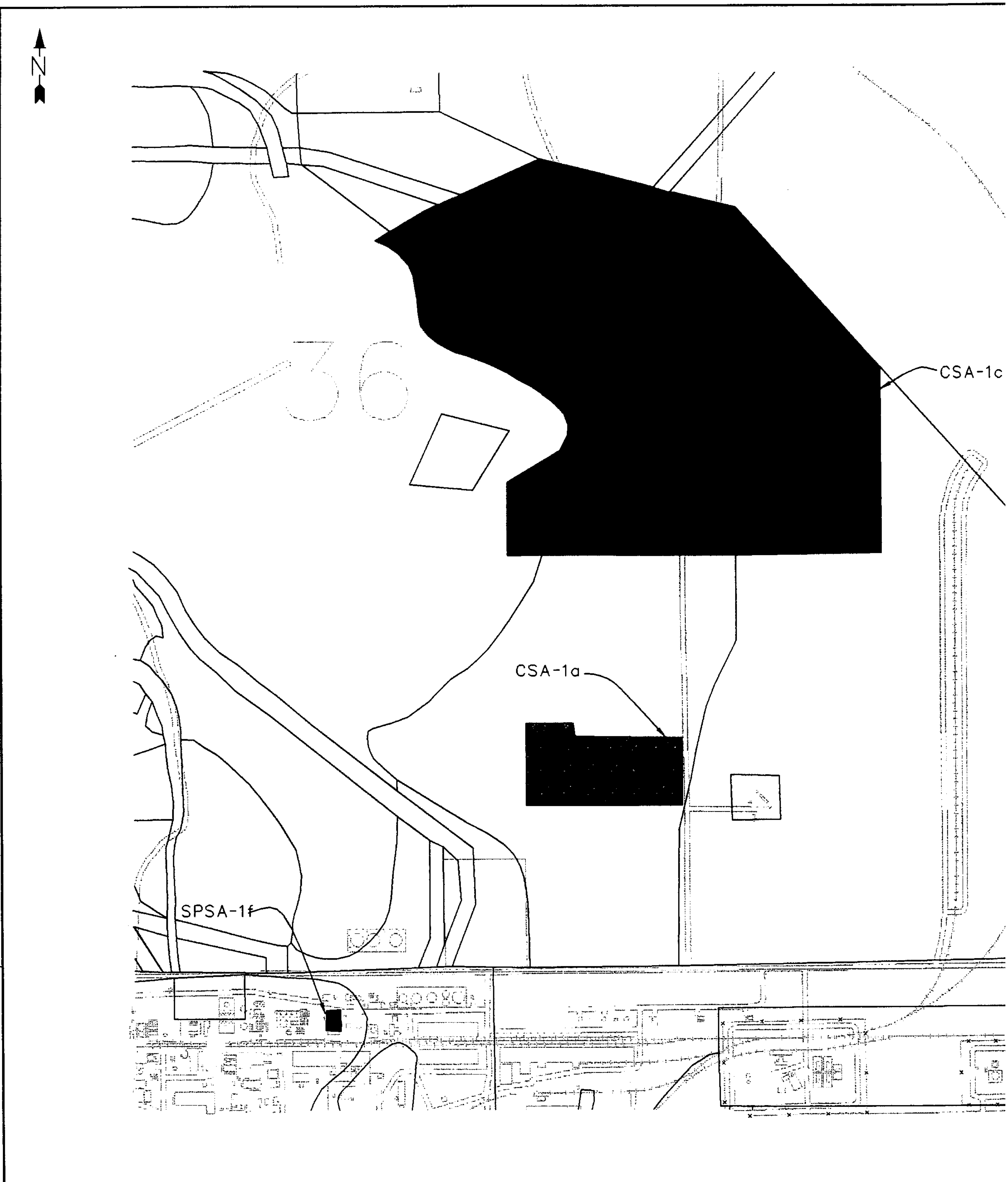
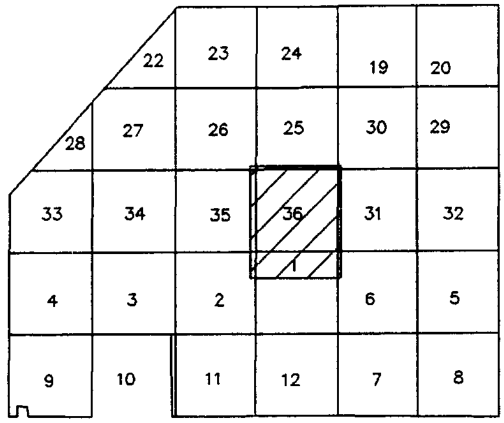
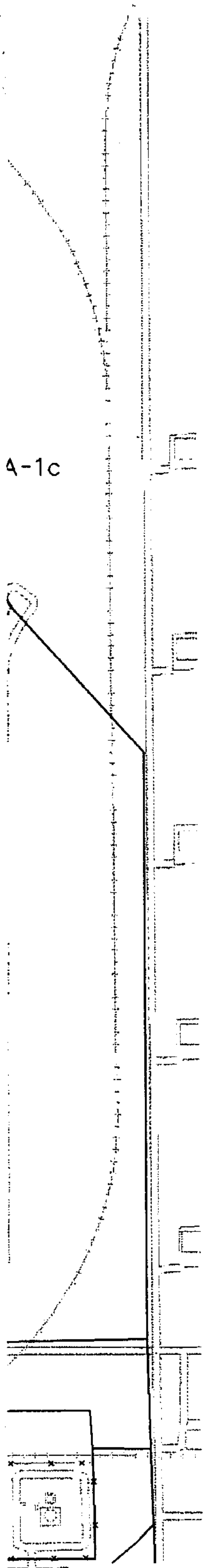


ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Complex Disposal Trenches Subgroup
SITE:CSA-1c, Complex Disposal Area North

Shell Trenches Subgroup
SITE:CSA-1a, Pesticide Pits

Hex Pit Subgroup
SITE:SPSA-1f, Buried Hex Pit

Site Boundary

Buildings and Roads

36 Section Number

300 0 300 600 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 14.0-1

Site Locations
Disposal Trenches Medium Group

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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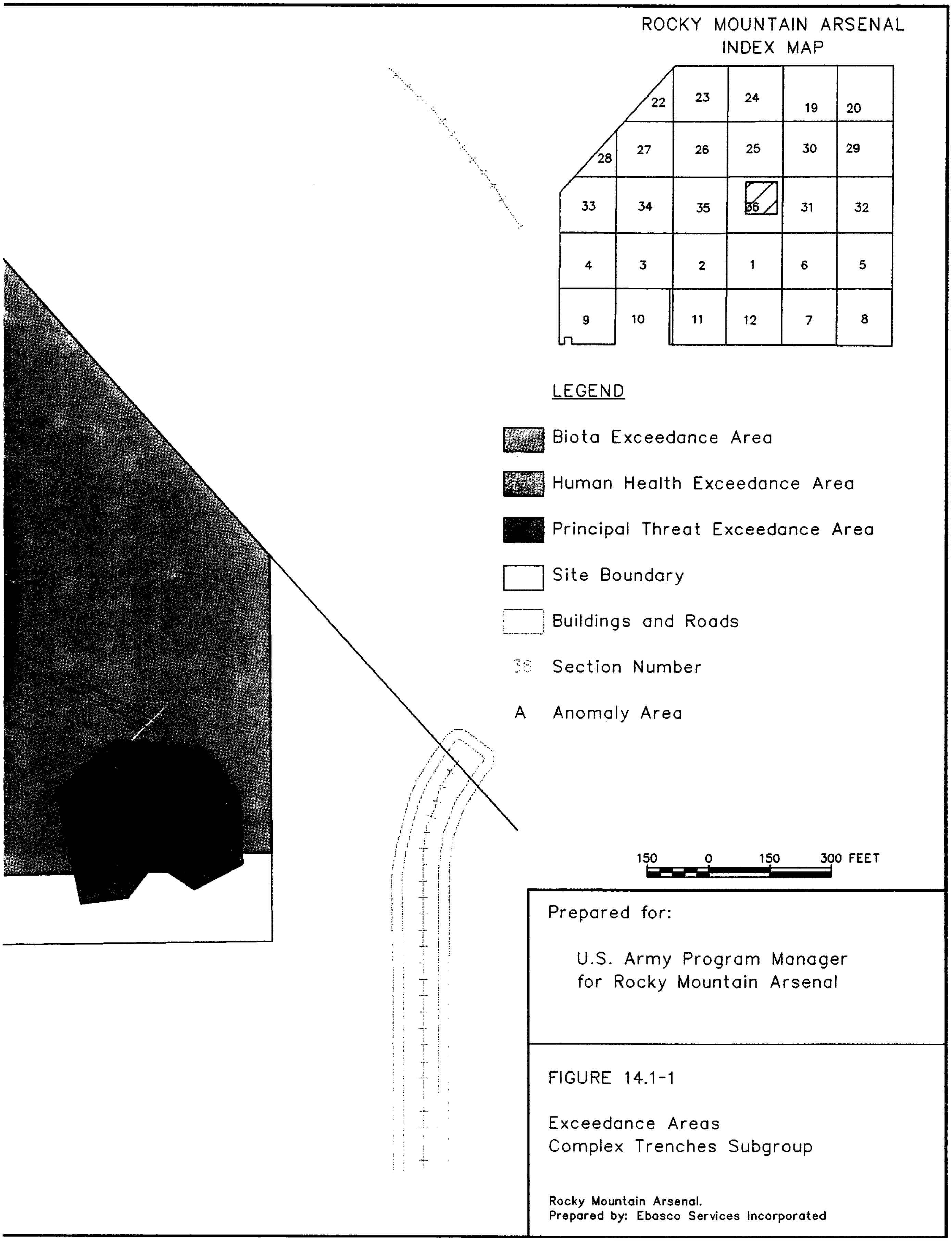

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 14.1-1

Exceedance Areas
Complex Trenches Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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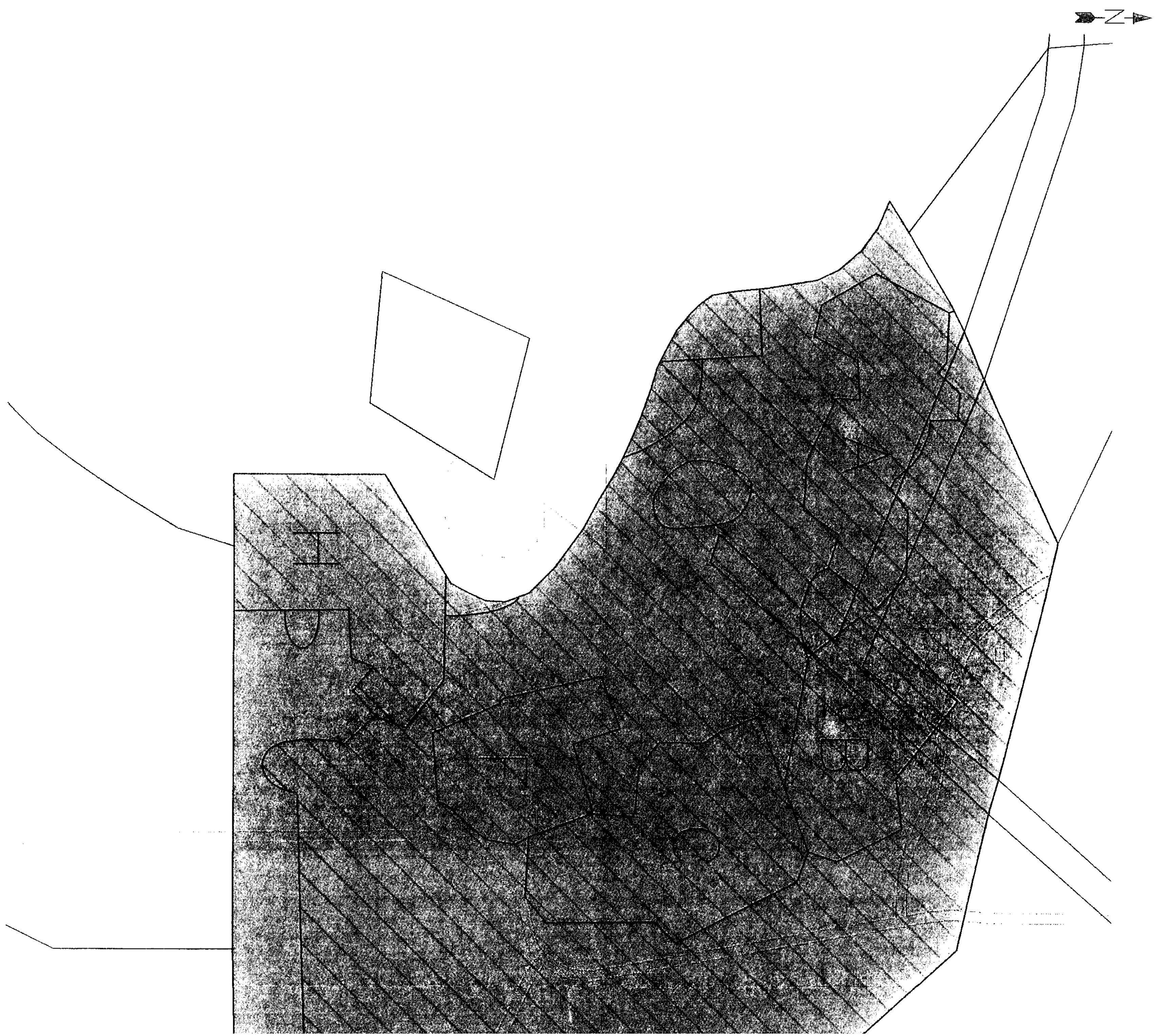
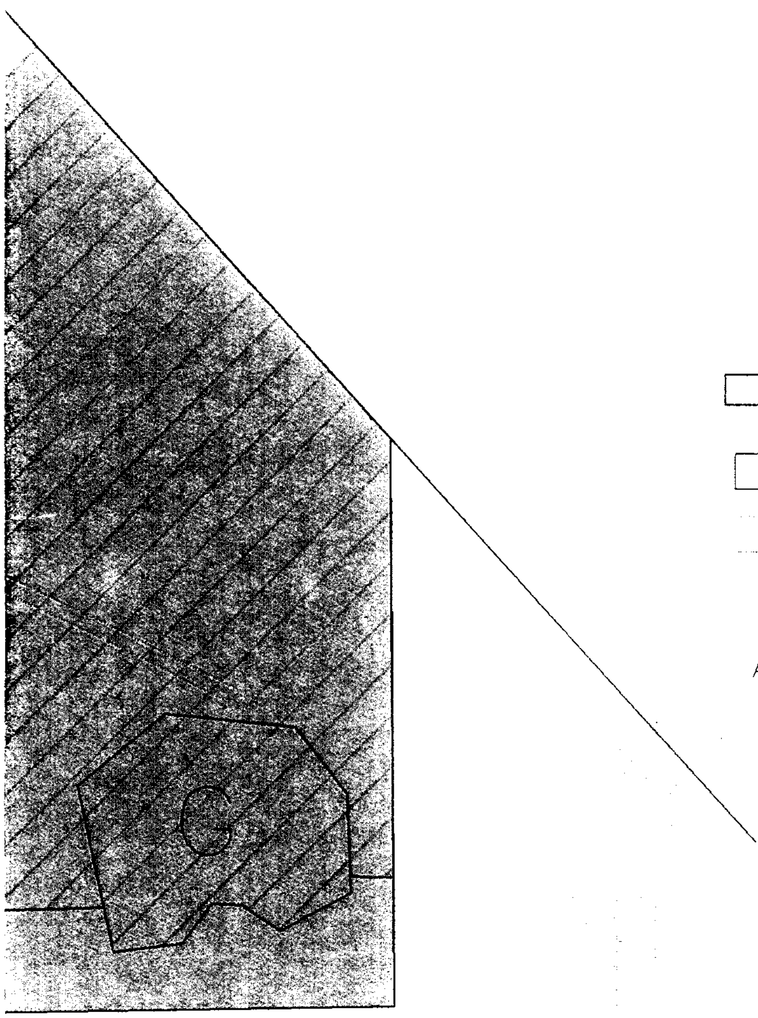
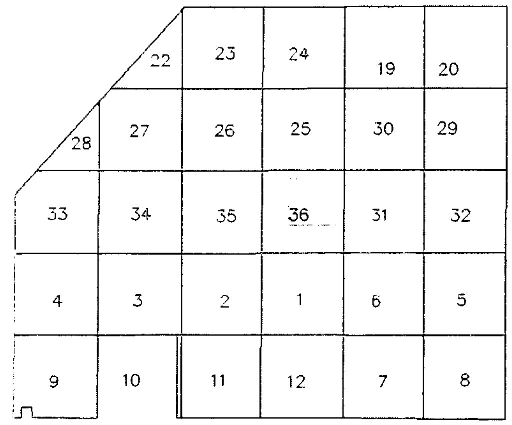




ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Human Health/Biota Exceedance Area

Potential Agent and UXO Presence Area

Site Boundary

Buildings and Roads

Section Number

A Anomaly Area

150 0 150 300 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 14.1-2

Potential Agent/UXO Presence Areas
Complex Trenches Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

15.0 DETAILED ANALYSIS OF ALTERNATIVES FOR THE SANITARY LANDFILLS MEDIUM GROUP

The Sanitary Landfills Medium Group is composed of eight sites consisting of sanitary landfills and landfill trenches located in various areas of RMA (Figure 15.0-1). These sites primarily contain trash and rubbish, and differ from sites within the Disposal Trenches Medium Group by the absence of containerized wastes (drums), agent, and UXO.

The primary Human Health and Biota COCs in this medium group are OCPs and ICP metals; no principal threat areas were identified in this medium group. Portions of the medium group contain mercury above Biota SEC, but not above Human Health SEC. Sites within this medium group are also potential sources of groundwater contamination as identified in the RISR (EBASCO 1992a/RIC 92017R01). Table 15.0-1 presents the characteristics of the Sanitary Landfills Medium Group, including exceedance volumes and COCs, and Appendix A presents the calculation of exceedance volumes and areas for this medium group.

In the DSA, alternatives were developed and screened based on the general characteristics of the medium group. In the DAA, individual subgroups were not developed for these eight sites, so the retained alternatives apply to the Sanitary Landfills Medium Group as a whole. The characteristics of the medium group—including contaminant types and contaminant concentrations, site configuration, and depth of contamination—were reviewed to determine whether any modifications to the alternatives retained from the DSA for the medium group would be appropriate. The alternatives for this medium group were not changed.

The following sections present the characteristics of the medium group, an evaluation of the retained alternative against the DAA criteria listed in the NCP (EPA 1990), and the selection of a preferred alternative based on a comparative analysis of the alternative evaluations. The preferred alternative is as follows:

- Alternative 3—Excavation of the soils with human health and biota exceedance volumes and disposal of the soils and debris in the on-post landfill.

15.1 MEDIUM GROUP CHARACTERISTICS

The Sanitary Landfills Medium Group is composed of sites CSA-1d (Sanitary Landfill and Incinerator 634), ESA-2b (Sanitary Landfill), SSA-4 (Trash Dump), WSA-2 (West Landfill), WSA-3c (Surface Disposal Area), WSA-5a (Inferred Trench), WSA-5c (Inferred Trench), and WSA-5d (Trenches) (Figure 15.0-1). These sites include the contaminated soils surrounding the landfills. The soils and debris contained within the landfills consists of rubbish, construction debris, wood, paper, asbestos, and metal piping. The contamination patterns within the landfill materials are heterogenous as various materials were disposed in the same landfill trench. Most of the landfills are not surrounded by biota exceedance areas (Figure 15.1-1). The biota exceedances comprise a small percentage of the total exceedance volume (Table 15.0-1).

Table 15.1-1 provides a summary of contaminants, exceedance volume concentrations, and the corresponding exceedance values for this medium group. Table 15.1-2 summarizes the frequency of detections for samples taken at sites in this medium group. The maximum concentrations of OCPs, ICP metals, and mercury exceed the Human Health SEC, and the average concentrations of isodrin, cadmium, and chromium are also above the Human Health SEC. Greater than 98 percent of the samples for human health exceedance contaminants did not exceed Human Health SEC (Table 15.1-2). The Biota SEC is exceeded for dieldrin and mercury at maximum concentrations of 4 ppm and 2.1 ppm, respectively. The Human Health COCs were detected at depths ranging from the ground surface to approximately 10 ft below ground surface. Biota COCs were found in 3,200 BCY of shallow soils (0- to 5-ft depth internal) surrounding the landfills (Table 15.0-1).

Sites within the Sanitary Landfills Medium Group contain poor- to moderate-quality habitat. In most of the alternatives for this medium group, the areas disturbed during remedial actions are revegetated with native grasses in accordance with a refuge management plan, and in most

instances, the overall habitat is improved, which should offset the short-term loss of habitat resulting from remedial actions. The Institutional Controls alternative includes provisions for modifying the habitat by seeding lower-quality grasses to reduce the desirability of the area as habitat for biota. In this instance, the habitat quality is lowered and the available habitat area on RMA is reduced by 150,000 SY. A small area in site CSA-1d has a high-quality, irreplaceable habitat, but this area is located outside of the landfill trench area. In addition, several of the sites are located within the Bald Eagle Management Area. Therefore, the evaluation of alternatives for this medium group must consider the impacts of alternatives on the habitat within these sites.

The sites in the Sanitary Landfills Medium Group have been identified as historical sources of groundwater contamination. In addition, site WSA-2 has been further identified as a potential groundwater plume source. This plume occurs in the unconfined aquifer in the western tier of RMA and is intercepted and treated by the Irondale Containment System. As discussed in the Water DAA, the levels of VOCs in the groundwater are slightly higher downgradient from the site, although the generally low levels of contamination within the plume do not warrant the evaluation of groundwater alternatives related to this specific site. Although the treatment or containment of this medium group may reduce the leaching of contaminants to groundwater, it is unlikely that the boundary systems could be shut down following the remediation of the Sanitary Landfills Medium Group due to the small amount of contamination that these sites contribute to the groundwater.

15.2 EVALUATION OF ALTERNATIVES

The alternatives for the Sanitary Landfills Medium Group vary in approach from no action to treatment. One of the alternatives retained from the DSA for this medium group was renamed to indicate clearly that the treated soil and debris are placed in a landfill following thermal desorption (Alternative 13b versus Alternative 13). The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this medium group consist of an alternative to address the human

health exceedances within the landfill materials, which are listed first, and a biota alternative (the "B" alternative), which addresses the biota exceedances outside the landfill trenches.

15.2.1 Alternative 1/B1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), applies to all 150,000 SY of exceedance area in the Sanitary Landfills Medium Group. The 430,000 BCY of soils with human health and biota exceedance volumes remain in place. No actions are taken to reduce potential human or biota exposure to COCs or to reduce the limited potential for groundwater contamination from this group. Exceedance areas are monitored (an average of 20 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 15.2-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative does not achieve Human Health or Biota RAOs as untreated soils remain in place without controls being implemented. The residual risk is low due to the low levels of contamination in the soils. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The quality of habitat at the sites is not changed, and groundwater impacts are not reduced. The total estimated present worth cost of this alternative is $1,300,000. Table B4.11-1 details the costing for this alternative.

15.2.2 Alternative 2/B2: Access Restrictions

Alternative 2: Access Restrictions (Modifications to FFA), along with Alternative B2: Biota Management (Exclusion, Habitat Modification), applies to the total exceedance area of 150,000 SY in the Sanitary Landfills medium group. The biota and human health exceedance volume of 430,000 BCY remains in place, but exposure pathways are interrupted. Human and biota access to the sites is restricted by the installation of 23,000 ft of perimeter chain-link fencing. Signs prohibiting access to the site are posted along the fence. The importance of maintaining and respecting access restrictions to prevent exposure is presented in an ongoing

public education program. In addition, biota exclusion is promoted by revegetating exceedance areas with grasses unappealing to biota to reduce the value of the habitat. Revegetation of the 150,000 SY of exceedance area is accomplished over a 3-year period. Long-term activities include maintaining fences, mowing and spot herbiciding revegetated areas, and monitoring for erosion and vegetation damage. No actions are taken to reduce the limited potential for groundwater contamination from sites in this group. Exceedance areas are monitored (an average of 20 samples per year) and 5-year site reviews are conducted to review the effectiveness of the alternative and to assess natural attenuation/degradation and potential migration of contaminants.

Table 15.2-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs by interrupting exposure pathways, so there is a low residual risk of exposure. Long-term maintenance is required to ensure the effectiveness of the access controls. Human health and biota exceedances remain in place, although natural attenuation of contamination is ongoing. The minimal groundwater impacts are not addressed. The 150,000 SY of habitat present in this medium group is eliminated for biota. The total estimated present worth cost of this alternative is $2,600,000. Table B4.11-2 details the costing for this alternative.

15.2.3 Alternative 3/B3: Landfill

Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill), consists of containing 430,000 BCY of contaminated soils and debris from the landfill trenches in the Sanitary Landfills Medium Group. The contaminated soil and debris is excavated and placed in a centralized on-post landfill as described in Section 4.6.6. The landfill is a multiple cell facility requiring 1 year for construction of the first cell and associated facilities. A final cover, placed over the landfill upon closure, is vegetated to limit erosion and facilitate surface-water runoff. A leachate collection and treatment system is constructed to ensure there is no migration of leachate into the groundwater, and a fence is installed at the landfill to exclude biota. Since 430,000 BCY of untreated soils and debris from the landfill trenches are contained

in the landfill, the landfill cell requires long-term monitoring and maintenance, which includes cover maintenance and leachate collection.

The site excavations are backfilled with borrow soils from the on-post borrow area. Topsoil, obtained from off post, is placed in the backfilled area, and the area is revegetated with native grasses to improve the habitat at the site. The borrow area is also recontoured and revegetated to restore habitat.

Table 15.2-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs and provides for the long-term protection of groundwater, since the contaminated soils are excavated and transferred to a containment cell. The habitat is improved at the site and restored at the borrow area. The disposal of the 430,000 BCY of human health and biota volumes requires approximately 2 years, based on the 1-year construction period for the landfill cell. Long-term maintenance of the landfill cap, collection and treatment of any leachate generated, and groundwater monitoring are required. The total estimated present worth cost of this alternative is $27,000,000. Table B4.11-3 details the costing for this alternative.

15.2.4 Alternative 5/B5a: Caps/Covers; Vertical Barriers

Alternative 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls), along with Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation, provides containment of the 430,000 BCY of soils with human health and biota exceedances with a 150,000-SY clay/soil cap. A soil/bentonite slurry wall (varying in depth between 16 to 96 ft below grade) is installed around the perimeter of each site (23,000 linear feet total) into competent bedrock. The slurry wall is constructed with a slurry mix using the soils excavated from the slurry trench. The soils excavated from the slurry wall trench in excess of the mixing requirements are graded over the surface of the isolation cell and included under the cap. A dewatering system is installed to create a reduced hydraulic head within the cell, minimizing the potential for further contaminant migration via groundwater. Based on the hydraulic conditions present for the sites in this medium group, long-term hydraulic controls with pumping are not necessary. If the dewatering

system were required, however, it would pump the water to the CERCLA wastewater treatment plant. The 3,200 BCY of biota exceedance soils are excavated and placed within the isolation cell as grading fill prior to capping. These excavations are backfilled with clean fill from the on-post borrow area. Topsoil, which is obtained off post, is placed on the backfilled area.

Following slurry wall installation and consolidation of biota exceedance soils, the clay/soil cap is constructed. The subgrade is compacted before any cover materials are installed, and the surface is graded to enhance surface-water drainage. Borrow material may be needed to bring the site to design grade. The biota exceedance areas (3,200 SY) outside of the landfill trenches are consolidated and used as grading fill. The area is then covered by 2 ft of low-permeability soil, a 1-ft biota barrier of cobbles, and 4 ft of common fill including 6 inches of topsoil. All disturbed areas are revegetated. Most of the fill materials for the cap are excavated from the on-post borrow area, and topsoil is obtained off post. The borrow area is recontoured and revegetated. Habitat is improved through revegetation. Restrictions for burrowing animals helps preserve the integrity of the cap. Long-term maintenance activities are conducted to ensure the continued integrity of the soil cover, repair any damage to the cap from erosion, and provide upkeep of the dewatering system. Five-year site reviews are conducted to review the effectiveness of the alternative.

Table 15.2-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs through containment. Habitat is improved at the site, but is restricted for burrowing animals in the capped area. The slurry wall installation, soil consolidation, and capping operations require 2 years to complete. The potential for migration of contaminants to groundwater is greatly reduced due to a reduction of infiltration at the site. However, long-term maintenance is required to ensure the integrity of the cap and dewatering system. The total estimated present worth cost of this alternative is $26,000,000. Table B4.11-5 details the costing of this alternative.

15.2.5 Alternative 13b/B6: Direct Thermal Desorption; Landfill

Alternative 13b: Direct Thermal Desorption (Direct Heating); Landfill (On-Post Landfill), paired with Alternative B6: Direct Thermal Desorption (Direct Heating), treats 430,000 BCY of soil with human health and biota exceedances by thermal desorption and landfilling. The sites are excavated and the debris is separated. The oversize debris is landfilled without treatment and the remaining debris and soil is thermally desorbed. The thermal desorber requires 1 year for construction and an additional year for testing. For dry soils, the thermal desorber has a processing rate of approximately 2,000 BCY/day and operates with a soils discharge temperature of 300°C and a soils residence time of 30 minutes. Section 4.6.24 discusses emission controls for off gases from thermal desporption. Due to the mercury content, 1 percent (4,300 BCY) of the soils feed from the scrubber blowdown is placed in a centralized on-post landfill along with the treated soils and debris.

The 430,000 BCY of thermally desorbed sanitary landfill materials are landfilled following treatment because there are elevated levels of metals in the treated materials and because the materials cannot be solidified due to the debris. The 3,200 BCY of soils with biota exceedances are backfilled on site following thermal desorption. The landfill is a multiple cell facility requiring 1 year for construction of the first cell and associated facilities. Section 4.6.6 presents a discussion of the construction of the on-post landfill. A fence is constructed around the perimeter of the facility to exclude biota, and a biota barrier is placed in the cover for protection against burrowing animals. A leachate collection system is placed in the liner of the facility to collect leachate generated for treatment. Long-term maintenance of the cover and monitoring of the leachate is required.

The 430,000 BCY of borrow material excavated from the on-post borrow area is placed in the excavated areas at each site. Topsoil, which is obtained off post, is placed over the borrow material and the site revegetated with native grasses to improve the habitat quality. The borrow area is recontoured and revegetated to restore the habitat.

Table 15.2-5 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs and provides for the long-term protection of groundwater since all contaminated soils are treated to remove or destroy the exceedance COCs. The habitat is improved at the site and restored at the borrow area. The thermal desorption and landfilling of 430,000 BCY of soil requires less than 1 year, but the construction and testing of the facilities requires 2 years before the soils are treated. Long-term monitoring of the site is not required; however, the landfill requires long-term cover maintenance, leachate collection and treatment, and groundwater monitoring. The total estimated present worth cost of this alternative is $82,000,000. Table B4.11-13b details the costing for this alternative.

15.3 SELECTION OF PREFERRED ALTERNATIVE

The Sanitary Landfills Medium Group has 430,000 BCY of exceedance soils containing OCPs, ICP metals, and mercury. The contamination pattern is heterogenous as various types of trash and rubbish were disposed in the same landfill trenches. Sites do not contain containerized waste, agent, or UXO. Some sites are potential sources of groundwater contamination. Less than 1 percent of the OCP samples and less than 2 percent of the ICP metal samples exceed the Human Health SEC (Table 15.1-2). The Biota SEC is exceeded for dieldrin in 21 percent and for mercury in 10 percent of the samples taken for the subgroup. In general, the average contaminant concentrations in the human health exceedance volume are below the Human Health SEC (Table 15.1-1), so the sites represent a relatively low risk to human health. There are no exceedances of the principal threat criteria.

Most of the sites within this medium group contain poor- to moderate-quality habitat and remedial alternatives do not cause significant impacts to habitat. Site CSA-1d has a small area of high-quality irreplaceable habitat located outside of the landfill trenches, and several sites are located within the Bald Eagle Management Area. The selection of a preferred alternative is not constrained by habitat-quality issues.

Alternatives that involve excavation of human health exceedances require protection of site workers during remedial activities, but the short-term risk to site workers is minimal with the use of proper PPE. The degree of contamination in sites in this subgroup does not necessitate special measures of vapor and odor control to protect the community.

In summary, the Sanitary Landfills Medium Group has heterogenous contamination in trenches that exceeds Human Health SEC. In selecting the preferred remedial alternative for this subgroup, the impact on limited areas of higher-quality habitat at some sites is not a major factor. Worker and community protection are readily provided and are not significant factors in the selection process.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs as the contaminated landfill materials are not controlled or treated. Therefore, this alternative is eliminated from further consideration as the preferred alternative. The four remaining alternatives achieve RAOs and meet the threshold criteria—i.e., they are protective of human health and the environment and comply with action-specific and location-specific ARARs—but differ in how they meet the five balancing criteria (Tables 15.2-1 through 15.2-5).

Alternative 2: Access Restrictions has the lowest cost of the remaining alternatives ($2,600,000), but does not remove or treat contaminated material and eliminates 150,000 SY of habitat outside of the central corridor of RMA. This alternative also does not reduce the relatively minor impacts to groundwater that are associated with this medium group. The treatment alternative, Alternative 13b: Direct Thermal Desorption; Landfill has a significantly higher cost ($82,000,000) than the containment alternatives. This alternative requires the disposal of the 430,000 BCY of a soils and debris mixture following treatment, but a significant portion of this volume consists of oversize debris that is landfilled without thermal treatment. The two containment alternatives, Alternative 3: Landfill and Alternative 5: Caps/Covers; Vertical Barriers, achieve similar reductions in mobility and exposure pathways and have similar costs ($27,000,000 and $26,000,000, respectively). However, Alternative 3: Landfill removes the contaminants and

improves habitat at the site. This alternative also reduces overall monitoring and maintenance costs at RMA by consolidating the areas to be contained into the centralized on-post landfill.

The preferred alternative for the Sanitary Landfills Medium Group is Alternative 3: Landfill. Long-term management and maintenance requirements for this alternative are less than the comparable containment alternative (Alternative 5: Caps/Covers; Vertical Barriers). The landfill alternative applies engineering controls to reduce contaminant mobility and interrupt exposure pathways, which makes the alternative cost effective compared to the treatment alternative (Alternative 13b: Direct Thermal Desorption; Landfill). The selection of this alternative is consistent with NCP guidance on the use of engineering controls to address low levels of contamination like those found in this medium group.

Table 15.0-1 Characteristics of the Sanitary Landfills Medium Group

Characteristic	Sanitary Landfills Medium Group
Contaminants of Concern	
Human Health	OCPs, ICP metals
Biota	OCPs, Hg
Exceedance Area (SY)	
Total	150,000
Human Health	150,000
Biota	3,200
Potential Agent	not applicable
Potential UXO	not applicable
Exceedance Volume (BCY)	
Total	430,000
Human Health	430,000
Organic	330,000
Inorganic	150,000
Principal Threat	0
Biota	3,200
Potential Agent	not applicable
Potential UXO	not applicable
Depth of Contamination (ft)	
Human Health	0-8
Biota	0-10

Table 15.1-1 Summary of Concentrations for the Sanitary Landfills Medium Group

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL-100	2.0	56	560	0.68
Dieldrin	BCRL-300	15	40	400	0.83
Endrin	BCRL-40	1.0	15	15,000	0.029
Isodrin	BCRL-30	15	3.4	3,400	not applicable
Chlordane	BCRL-3.1	1.3	3.1	260	not applicable
p,p,DDT	BCRL-90	22	26	1,300	1.4
Chromium	BCRL-1,800	140	40	10,000	not applicable
Lead	BCRL-2,000	430	1900	1,000,000	not applicable
Cadmium[1]	1,100	1,100	480	66,000	not applicable
p,p,DDE[2]	BCRL-5.5	1.8	130	1,300	0.2
Mercury[2]	BCRL-4.0	1.9	470	470,000	0.99
Biota Exceedance Volume					
Dieldrin[1]	4.0	4	40	400	0.83
Mercury	BCRL-2.1	1.1	470	470,000	0.99

1 Reported as an isolated exceedance.
2 Biota contaminant of concern is only present as overlap within human health exceedance areas.

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Table 15.1-2 Frequency of Detections for Sanitary Landfills Medium Group

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	229	213	93.0%	9	3.9%	6	2.6%	1	0.4%	0	0.0%
Benzene	143	139	97.2%	4	2.8%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	177	177	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	229	223	97.4%	5	2.2%	--	--	1	0.4%	0	0.0%
Chloroacetic Acid	45	45	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	177	177	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	177	176	99.4%	1	0.6%	--	--	0	0.0%	0	0.0%
p,p,DDE	229	223	97.4%	3	1.3%	3	1.3%	0	0.0%	0	0.0%
p,p,DDT	229	219	95.6%	7	3.1%	2	0.9%	1	0.4%	0	0.0%
Dibromochloropropane	256	256	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	177	177	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	256	254	99.2%	2	0.8%	--	--	0	0.0%	0	0.0%
Dieldrin	229	199	86.9%	8	3.5%	21	9.2%	1	0.4%	0	0.0%
Endrin	229	218	95.2%	1	0.4%	9	3.9%	1	0.4%	0	0.0%
Hexachlorocyclopentadiene	229	221	96.5%	8	3.5%	--	--	0	0.0%	0	0.0%
Isodrin	229	221	96.5%	7	3.1%	--	--	1	0.4%	0	0.0%
Methylene Chloride	177	165	93.2%	12	6.8%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	177	171	96.6%	6	3.4%	--	--	0	0.0%	0	0.0%
Toluene	143	143	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	177	176	99.4%	1	0.6%	--	--	0	0.0%	0	0.0%
Arsenic	202	167	82.7%	35	17.3%	0	0.0%	0	0.0%	0	0.0%
Cadmium	243	222	91.4%	20	8.2%	--	--	1	0.4%	0	0.0%
Chromium	243	63	25.9%	177	72.8%	--	--	3	1.2%	0	0.0%
Lead	243	151	62.1%	90	37.0%	--	--	2	0.8%	0	0.0%
Mercury	217	189	87.1%	18	8.3%	10	4.6%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 15.2-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants through natural attenuation; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sanitary Landfills Medium Group not located in wetlands or 100-year floodplain.
c) Guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. OCPs, and ICP metals above Human Health SEC and OCPs and mercury above Biota SEC remain in soil and may impact human health and biota. b) No controls implemented. Site reviews and groundwater monitoring required.
b) Adequacy and reliability of controls	c) Habitat quality not improved. Existing low- to moderate-quality habitat not impacted by remedial alternative.
c) Habitat impacts	
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume or mobility except by natural attenuation; 430,000 BCY of untreated soils remain.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residual	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Existing low- to moderate-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $1,300,000
d) Total	d) $1,300,000

Table 15.2-2 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative B2: Biota Management (Exclusion, Habitat Modification) for the Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. RAOs achieved as human and biota exposure pathways interrupted through access restrictions and biota controls; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as access adequately controlled and site reviews conducted; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sanitary Landfills Medium Group not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions to FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. OCPs, and ICP metals above Human Health SEC and OCPs and mercury above Biota SEC remain in place; fencing, land-use restrictions, and cultivation of lower- quality habitat reduce potential human and biota exposure.
b) Adequacy and reliability of controls	b) Adequate controls. Installation of fencing and land use restrictions reduce human exposure; controls adequate for small area; long-term maintenance, site review, monitoring of wildlife exclusion, and groundwater monitoring required.
c) Habitat improved	c) Habitat eliminated. Biota controls of fencing and cultivation of lower-quality habitat eliminate habitat for biota.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume or mobility except by natural attenuation for 430,000 BCY of untreated soils; human health and biota exposure pathways interrupted over 150,000 SY by fencing, biota controls, and land-use restrictions.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Exposure controls reversible if fencing or biota controls fail.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative. Contaminants remain in place.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during fence installation and cultivation of lower-quality habitat.
b) Protection of community during remedial action	b) Protective of community. Dust and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to poor- to moderate-quality existing habitat; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) 3 years. Installation of perimeter fencing within several months but cultivation of lower-quality habitat requires 3 years; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; additional remedial actions easily undertaken for soils left in place.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for fence installation and habitat modifications.

Table 15.2-2 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative B2: Biota Management (Exclusion, Habitat Modification) for the Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) \$750,000
b) Operating	b) \$68,000
c) Long-term	c) \$1,800,000
d) Total	d) \$2,600,000

Table 15.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-8)	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sanitary Landfills Medium Group and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 430,000 BCY of untreated soil contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat improved	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor- to moderate- quality habitat at site but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 430,000 BCY in on-post landfill.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing low- to moderate-quality habitat; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) 2 years. Excavation of 430,000 BCY feasible within 1 year after 1 year for construction of on-post landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.

Table 15.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $8,600,000
b) Operating	b) $17,000,000
c) Long-term	c) $1,700,000
d) Total	d) $27,000,000

Table 15.2-4 Evaluation of Alternative 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls); Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation for the Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained by clay/soil cap, slurry wall, and dewatering system, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5 and A-7)	a) Complies with action-specific ARARs regarding construction of CERCLA covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2	b) Complies with location-specific ARARs as Sanitary Landfills Medium Group not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 430,000 BCY of untreated soils contained through installation of 150,000-SY clay/soil cap, slurry wall, and dewatering system.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control, vegetative cover, slurry wall, and dewatering system maintenance required; high confidence in engineering controls of clay/soil cap and slurry wall.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-to moderate-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 150,000-SY clay/soil cap, slurry wall, and dewatering system; 3,200 BCY of soils above Biota SEC consolidated to reduce capped area.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap or slurry wall degrades or leaks.
d) Type and quantity of treatment residuals	d) Groundwater removed by dewatering system pumped to CERCLA Wastewater Treatment System.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of cap/cover and slurry wall and during dewatering.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; odor and vapor emissions not anticipated during excavation.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impacts to biota due to poor- to moderate-quality existing habitat; burrowing animals excluded from area; migration of groundwater reduced.
d) Time until RAOs are achieved	d) 2 years. Installation of 150,000-SY clay/soil cap, slurry wall, and dewatering system feasible within 2 years; natural attenuation of untreated soils ongoing.

Table 15.2-4 Evaluation of Alternative 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls); Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation for the Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; dewatering required; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover and slurry wall design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for clay/soil cap, slurry wall, and dewatering system construction; clay/soil caps, slurry wall, and dewatering system well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) \$2,400,000
b) Operating	b) \$20,000,000
c) Long-term	c) \$3,700,000
d) Total	d) \$26,000,000

Table 15.2-5 Evaluation of Alternative 13b: Direct Thermal Desorption (Direct Heating); Landfill (On-Post Landfill); Alternative B6: Direct Thermal Desorption (Direct Heating) for Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment and containment; contaminated soils treated to organic detection levels and contained in on-post landfill preventing exposure; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, and A-10)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation achieved; endangered species not impacted.
b) Location-specific ARARs	b) Complies with location-specific ARARs as Sanitary Landfills Medium Group, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 430,000 BCY thermally desorbed and contained in on-post landfill; approximately 1% of solids feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed area improves existing poor-quality habitat at site but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 430,000 BCY thermally desorbed to degrade OCPs and remove mercury and then contained in on-post landfill.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; scrubber blowdown solids from off-gas treatment equipment with mercury, ICP metals, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible; mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) 4,300 BCY of blowdown solids with mercury, ICP metals, and salts landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated from excavation; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing low- to moderate-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 430,000 BCY feasible within 1 year after 2 years construction of thermal desorption facility and landfill.

Table 15.2-5 Evaluation of Alternative 13b: Direct Thermal Desorption (Direct Heating); Landfill (On-Post Landfill); Alternative B6: Direct Thermal Desorption (Direct Heating) for Sanitary Landfills Medium Group

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; materials, specialists, and equipment readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $28,000,000
b) Operating	b) $54,000,000
c) Long-term	c) $1,200,000
d) Total	d) $82,000,000

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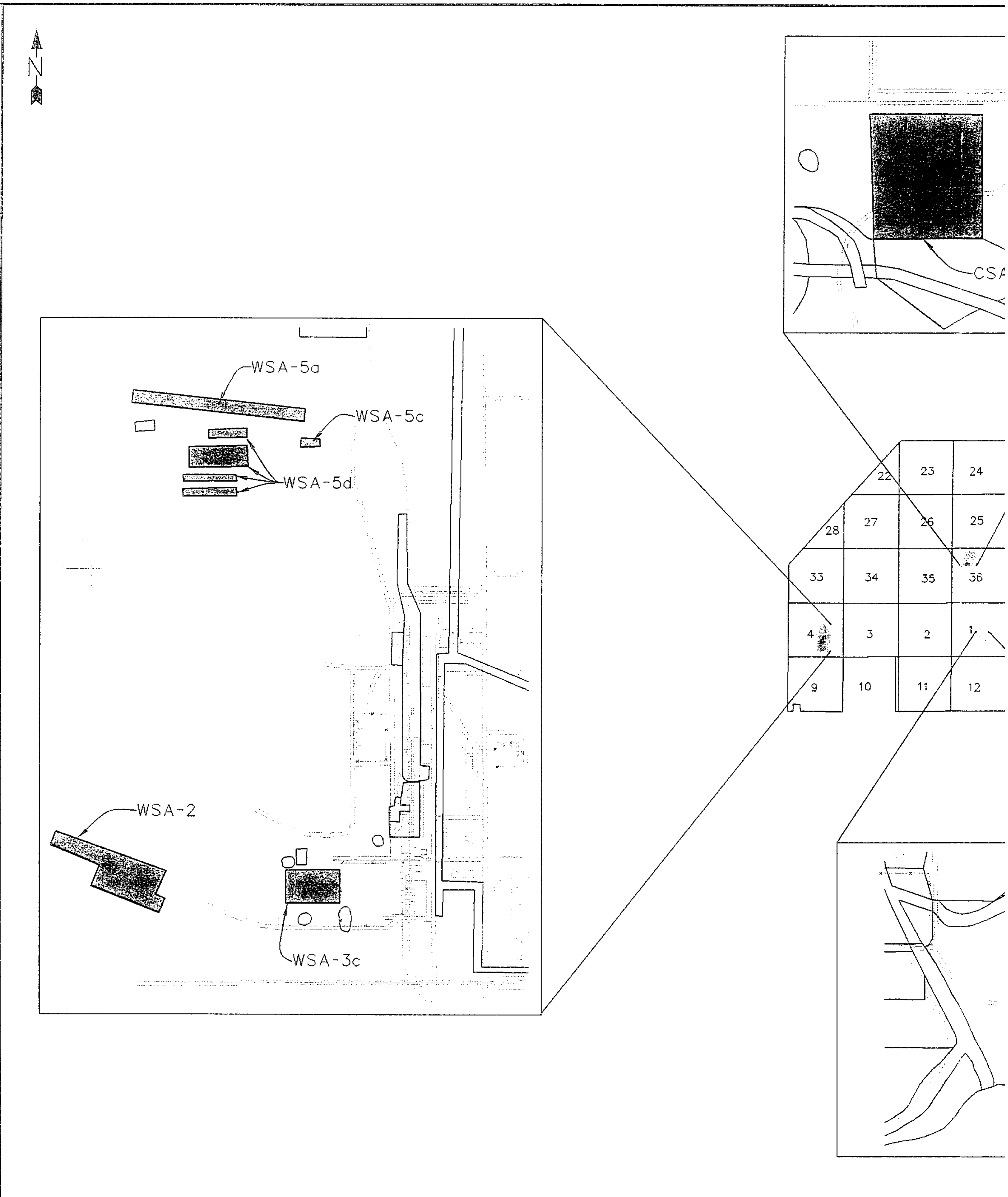

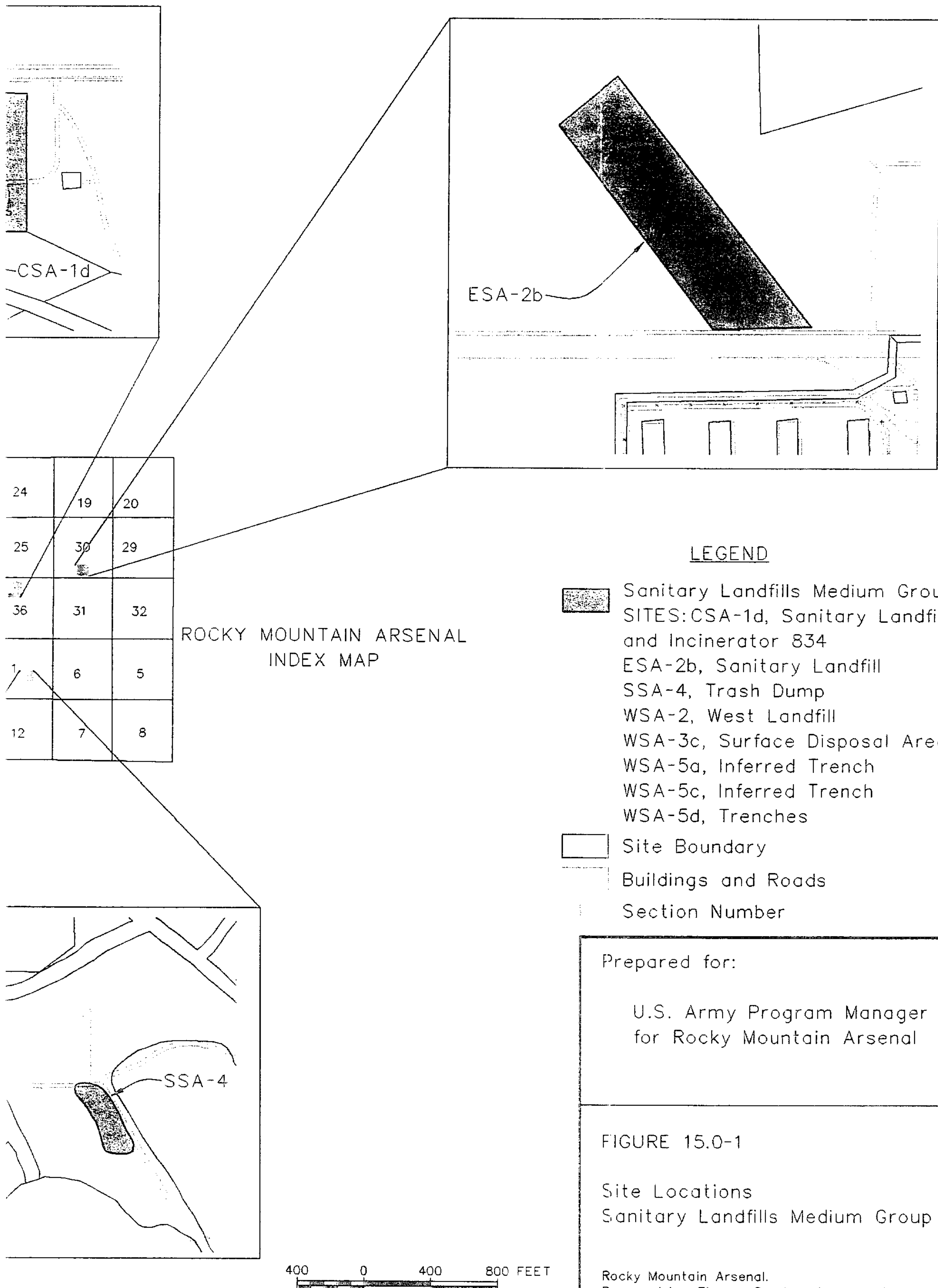

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 15.0-1

Site Locations
Sanitary Landfills Medium Group

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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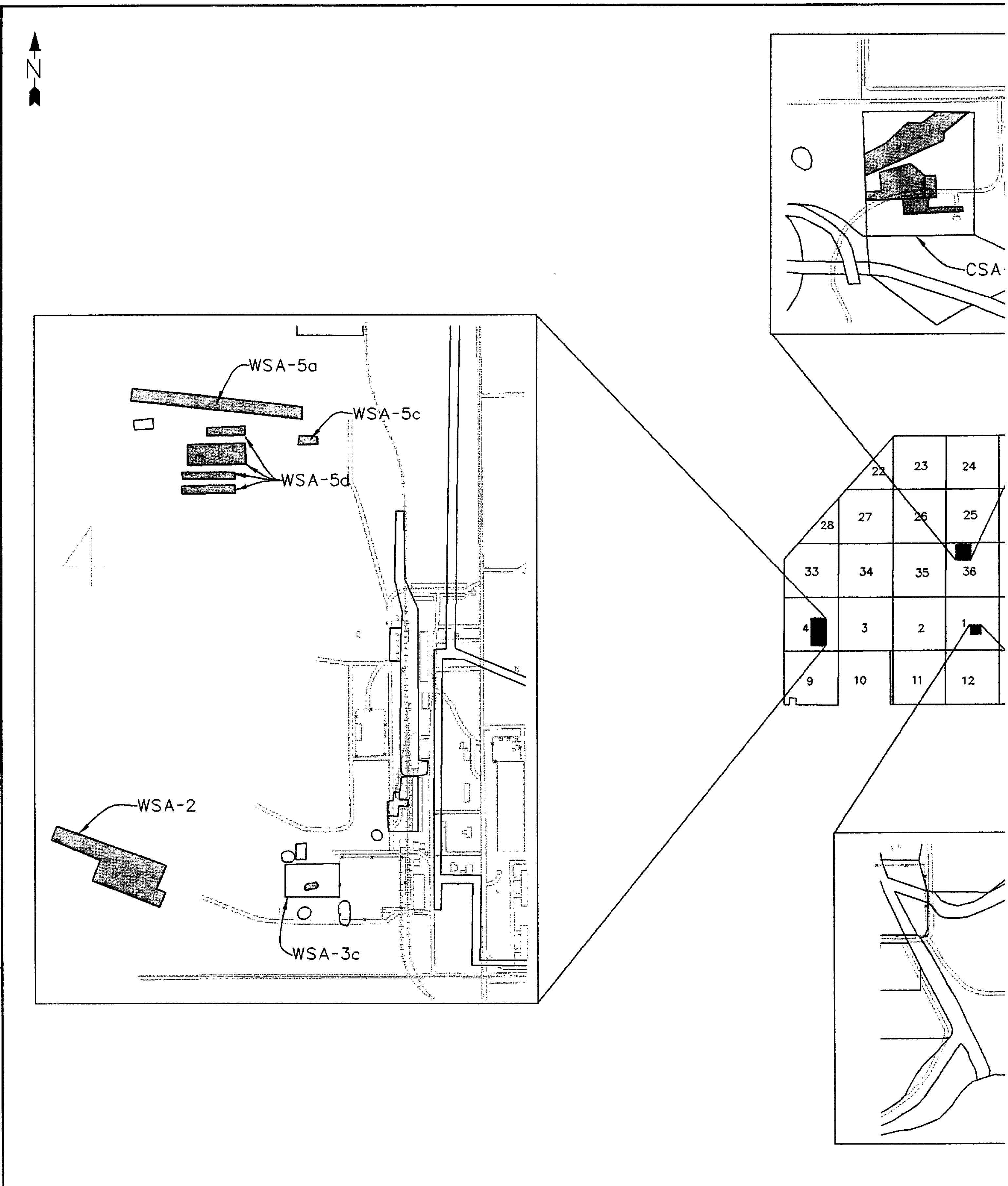

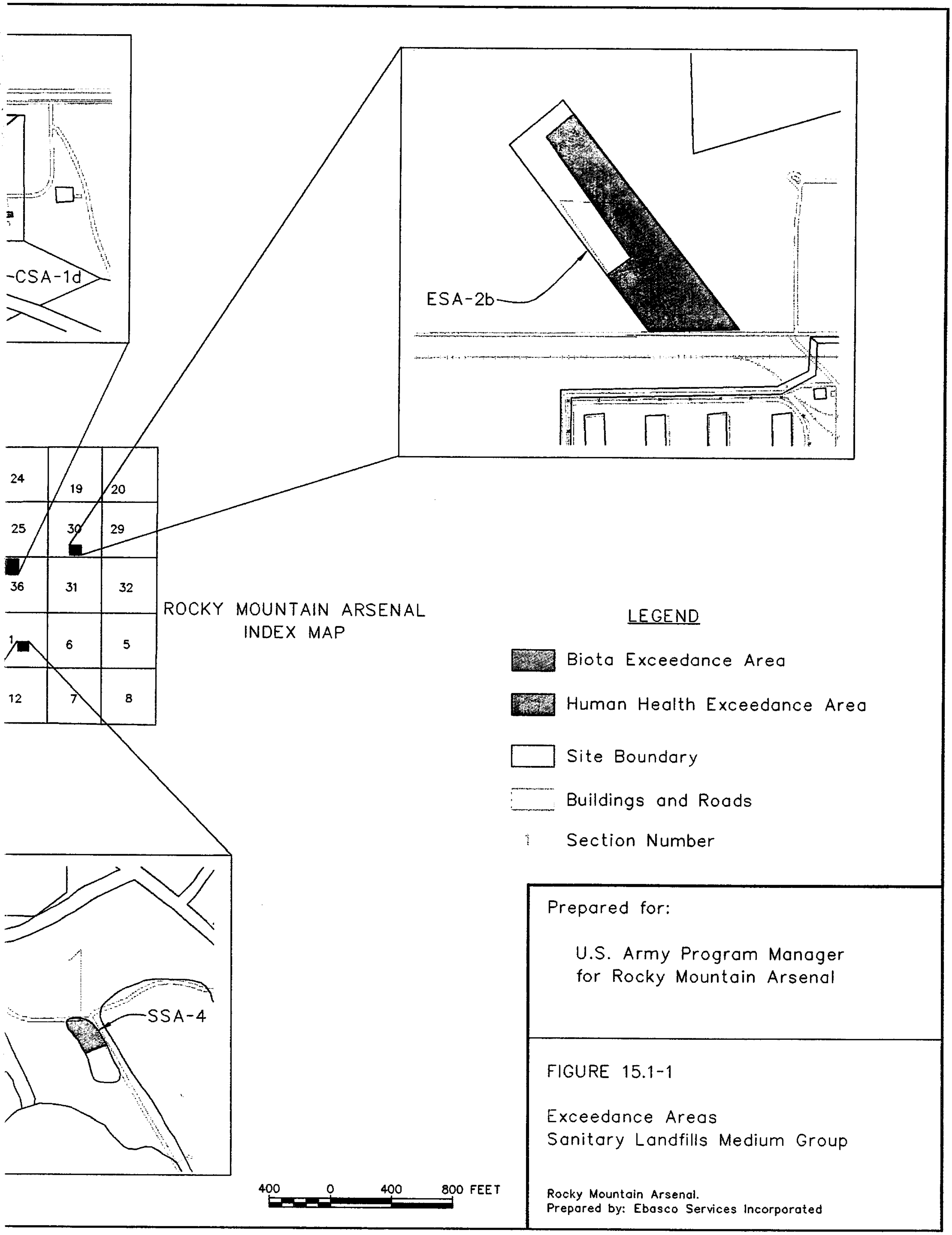

CSA-1d
ESA-2b
SSA-4
24
19
20
25
30
29
36
31
32
1
6
5
12
7
8
ROCKY MOUNTAIN ARSENAL
INDEX MAP
LEGEND
Biota Exceedance Area
Human Health Exceedance Area
Site Boundary
Buildings and Roads
Section Number
400 0 400 800 FEET
Prepared for:
U.S. Army Program Manager
for Rocky Mountain Arsenal
FIGURE 15.1-1
Exceedance Areas
Sanitary Landfills Medium Group
Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

16.0 DETAILED ANALYSIS OF ALTERNATIVES FOR THE LIME BASINS MEDIUM GROUP

The Lime Basins Medium Group is composed of two adjacent sites that have similar histories and contaminant types. These sites were used for the neutralization of process wastes related to agent production and are characterized by soil/sludge mixtures with high pH levels and the potential presence of agent. In addition, sites within this medium group are potential sources of groundwater contamination. This medium group is separated into two subgroups—Section 36 Lime Basins and Buried M-1 Pits—each containing one site. Figure 16.0-1 depicts the locations of the subgroups and their related sites.

The primary Human Health and Biota COCs in this medium group are OCPs. DCPD, arsenic, mercury, and cadmium above Human Health SEC and arsenic and mercury above Biota SEC are also present. Both subgroups contain contaminated areas that are considered principal threats and are potential sources of groundwater contamination. Table 16.0-1 lists the characteristics of the subgroups, including exceedance volumes and areas and COCs.

In the DSA, alternatives were developed and screened based on the general characteristics of the medium group. In the DAA, however, the retained alternatives do not necessarily apply to each subgroup. The characteristics of the two subgroups—including contaminants and contaminant concentrations, site configuration, and depth of contamination—were used to determine the subset of applicable alternatives for each subgroup from the range of alternatives retained in the DSA for the Lime Basins Medium Group.

For each subgroup, the following subsections present the characteristics of the subgroup, an evaluation of the retained alternatives against the DAA criteria listed in the NCP (EPA 1990), and the selection of a preferred alternative based on a comparative analysis of the alternatives. The preferred alternatives are as follows:

- Section 36 Lime Basins Subgroup: Alternative 6d—Augmentation of the existing cap with an additional clay/soil cap.

- Buried M-1 Pits Subgroup: Alternative 10—Excavation and cement-based solidification of soils above human health exceedances following agent screening of site and treatment of any soils identified with agent.

16.1 SECTION 36 LIME BASINS SUBGROUP CHARACTERISTICS

The Section 36 Lime Basins Subgroup consists of site NCSA-1b (Lime Settling Basins Area) (Figure 16.0-1). The three individual basins within the site were used to remove arsenic from South Plants wastewater by precipitation. Wastewater, generated both by manufacturing processes and later by the demilitarization of lewisite, was treated with lime at the site to precipitate metals and reduce arsenic concentrations. As a result, 34,000 SY of this subgroup potentially contain agent-contaminated soils. The basins were also constructed to receive wastewater from industrial activities conducted at South Plants until the chemical sewer was constructed. A 1.5-ft-thick compacted soil cap and a 6-inch layer of topsoil was placed over the site as part of the Lime Basins IRA to reduce groundwater contamination. Construction of a slurry wall was planned, but munitions casings found during excavation halted its installation. Contaminated soils and sludges from outside the basin were excavated and consolidated within the center of the site as grading fill prior to the installation of the soil cap.

Table 16.1-1 provides a summary of contaminants, exceedance volume concentrations, and corresponding exceedance values for this subgroup. Table 16.1-2 summarizes detections for samples taken in this subgroup. At most, 15 percent of the samples for individual OCPs exceed the Human Health SEC, and the average concentrations of OCPs in the human health exceedance volume exceed the Human Health SEC. Maximum concentrations of aldrin, dieldrin, and chlordane (3,300 ppm, 1,500 ppm, and 470 ppm, respectively) exceed the principal threat criteria (10^{-3} excess cancer risk, HI of 1,000) in 1,000 BCY, however, an additional 18,000 BCY of overburden would have to be removed to address the isolated principal threat exceedance. Because of the difficulties associated with identifying and removing this isolated exceedance, specific alternatives to address principal threat treatment or containment were not developed. Figure 16.1-1 presents the Human Health and Biota exceedance areas. Figure 16.1-2 shows the overlap between the potential agent presence areas and the exceedance areas. The Biota SEC are

exceeded by OCPs, arsenic, and mercury in 93,000 BCY. Biota exceedances of arsenic, mercury, p,p,DDE, and p,p,DDT overlap the human health exceedance volume. The Human Health COCs were detected at depths ranging from 0 to 8 ft below ground surface; however, the majority of the contaminants are found in the upper 5 ft of soils. Biota COCs are found between 0 and 10 ft below ground surface.

The Section 36 Lime Basins Subgroup consists of poor-quality habitat based on the vegetation types encountered at the site. The areas disturbed during remedial actions are revegetated with native grasses, so the overall habitat value is improved through remedial actions. However, burrowing animals are excluded from areas of the site that are addressed through modifications to the existing cap/cover.

This subgroup has been identified as the source of a groundwater contamination plume that occurs in the unconfined aquifer in conjunction with the Basin A Plume. The Basin A Plume follows the Basin A Neck paleochannel to the northwest where it is intercepted and treated by the Basin A IRA treatment system. The cap installed as part of the Lime Basins IRA reduces groundwater contamination, thereby decreasing the migration of contaminants from the basins' soils and sludges to groundwater. Groundwater alternatives that address improved performance for the Basin A IRA treatment system or the addition of individual plume group remediation systems are being evaluated. Coordination of alternatives developed for the soils medium with those developed for the water medium for the Basin A Plume Group is limited to capping or excavation. Due to the contaminant mass loading already in the aquifer, it is unlikely that the remediation of the Section 36 Lime Basins could result in the discontinuation of the Basin A Neck IRA treatment system.

16.2 SECTION 36 LIME BASINS SUBGROUP EVALUATION OF ALTERNATIVES

The alternatives evaluated for the Section 36 Lime Basins Subgroup vary in approach from no action to treatment. The retained alternatives for the Section 36 Lime Basins Subgroup were modified to clearly indicate that treatment of inorganic contamination by solidification is not

required following treatment of organic contamination (Alternative 19a versus 19b). In addition, Alternative 5c was changed to Alternative 6d to eliminate the use of slurry walls. Slurry walls were removed from the alternatives for this subgroup because groundwater contamination is currently being reduced by the Basin A Neck system and is more appropriately addressed by alternatives developed for the Basin A Plume Group in the Water DAA. Due to the low concentrations of inorganics, Alternatives 10 and 21, which address high levels of inorganics, were removed from the range of alternatives. Alternative 13a, however, was added to the range of alternatives to address the organics contamination, which is the predominant contamination in this subgroup, and a containment alternative (Alternative 5c) was added to augment the existing containment system.

The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address areas of human exceedances (which is listed first), an alternative to address areas of biota exceedance (the "B" alternative), and an alternative to address areas with the potential presence of agent (the "A" alternative).

16.2.1 Alternative 1/B1/A1: No Additional Action

Alternative 1: No Additional Action (Provisions of FAA), along with Alternative B1: No Additional Action (Provisions of FFA) and Alternative A1: No Additional Action (Provisions of FFA), applies to all 63,000 SY of exceedance area in the Section 36 Lime Basins Subgroup. The 200,000 BCY of total exceedance volume, including human health, biota, and potential agent exceedances, remain in place. No additional action beyond maintenance of the existing IRA soil cap is taken to reduce human or biota exposure to COCs or migration of contaminants to groundwater. This alternative complies with provisions of the FFA. Exceedance areas are monitored (an average of 13 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 16.2-1 presents an evaluation of Alternative 1 against the EPA criteria for the DAA. Human Health RAOs for exposure are achieved through the cap constructed under the IRA. Biota RAOs are not achieved under this alternative as untreated soils remain in place without controls to prevent biota exposures. Natural attenuation may occur, but the estimated time frame to achieve PRGs is more than 30 years. The residual risk is moderate due to moderate levels of contamination remaining in the soils. The poor-quality habitat at the site is not changed, and groundwater impacts are not addressed. Costs associated with existing cap maintenance, long-term soil monitoring, and site reviews result in a total estimated present worth cost of $1,600,000. Table B4.12-1 details the costing for this alternative.

16.2.2 Alternative 6d/B5: Caps/Covers with Modifications to Existing System

Alternative 6d: Caps/Covers (Clay/Soil Cap) with Modifications to Existing System, in combination with Alternative B5: Caps/Covers (Clay/Soil Cap), involves the installation of a 63,000-SY low-permeability soil cap to contain the human health and biota exceedance areas. (Section 4.6.8 discusses low-permeability soil caps in detail.) The top 2 feet of the existing soil cover are excavated and the soil is stockpiled for use in the cover. The subgrade is compacted before any cover materials are installed. The cap consists of a 2-ft layer of compacted low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. The stockpiled material from the existing cover is used as part of the soils required for the soil/vegetation layer. An on-post borrow area supplies the remaining materials for the cap, with the exception of top soil, which is obtained off post. The cap is revegetated and burrowing animals are excluded to prevent damage to the containment system. The borrow area is recontoured and revegetated. Maintenance activities, such as grass mowing and replacement of eroded cap materials, ensures the continued integrity of the soil cover. Five-year site reviews are conducted to review the effectiveness of the alternative and to assess potential migration of contaminants.

Table 16.2-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through containment. The cap

reduces the potential for migration of contaminants to groundwater by reducing infiltration and interrupts human health and biota exposure pathways. The capping operations take approximately 1 year to complete, and habitat is improved at the site after remediation, although burrowing animals are excluded from the area. Long-term maintenance is required to ensure the integrity of the cap. The total estimated present worth cost of this alternative is $4,900,000. Table B.12-6d details the costing for this alternative.

16.2.3 Alternative 13a/B6/A4: Direct Thermal Desorption

For the Section 36 Lime Basins Subgroup, Alternative 13a: Direct Thermal Desorption (Direct Heating), paired with Alternative B6: Direct Thermal Desorption (Direct Heating) and Alternative A4: Incineration/Pyrolysis (Rotary Kiln), treats 200,000 BCY of contaminated soils by excavation and thermal treatment. Prior to excavation of the contaminated soils, 42,000 BCY of the existing soil cover is removed and set aside. Installation of a dewatering system 2 years prior to excavation lowers the groundwater table prior to and during excavation activities. Groundwater removed at 0.2 gpm during dewatering is pumped to the CERCLA Wastewater Treatment Plant. To reduce odor emissions, minimal area is excavated and exposed to the atmosphere at any one time, and daily soil covers or plastic liners are placed over the excavated areas to further control odors and reduce volatile emissions.

Prior to excavation, 34,000 SY of soils that potentially contain agent are screened with real-time field analytical methods. The excavated soils are stockpiled and covered. Upon verification of the absence of agent, the soil is transported to the centralized thermal desorption facility for treatment. If agent is identified, the agent-contaminated soils are treated on post by rotary kiln incineration. It is estimated that approximately 90 BCY of soils in this subgroup contain agent. Operating parameters of the rotary kiln include an operating temperature of 760°C, residence time of 66 minutes, and processing rate of approximately 400 BCY/day. (Section 4.6.24 discusses emission controls for off gases associated with incineration.) Approximately 1 percent of the soils feed is entrained in the off-gas stream and recovered in the scrubber blowdown. The

recovered particulates, 1 BCY, are placed in an on-post hazardous waste landfill due to high inorganic concentrations and salts. The treated soils are returned to the site as backfill.

Exceedance soils that do not contain agent are treated in a centralized thermal desorber. The thermal desorber has a soils processing rate of approximately 1,300 BCY/day based on the saturated conditions of the soils (i.e., moisture content of 20 percent) and operates with a soils discharge temperature of 300°C and a soils residence time of 50 minutes. When operating under these conditions, the thermal desorber volatilizes all of the mercury and much of the arsenic present, eliminating the need for solidification of the treated soils. (Section 4.6.24 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the soils feed is entrained in the off-gas stream and recovered from the scrubber blowdown. Due to the mercury and arsenic they contain, approximately 2,000 BCY of blowdown particulates are placed in the on-post hazardous waste landfill. The treated soils are returned to the site excavations as backfill. Since thermal desorption destroys the natural organic content of the soils, the excavated soil cover of 63,000 SY is put back on top of the treated soils and is revegetated with native grasses to improve the quality of the habitat.

Table 16.2-3 presents an evaluation of Alternative 13a against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs since all contaminated soils are treated to remove or destroy the exceedance COCs. The habitat is improved at the site and the potential for migration of contaminants to groundwater is reduced through treatment. Thermal desorption of 200,000 BCY of contaminated soils takes approximately 3 years, including 2 years for the construction and testing of the facility. The total estimated present worth cost of this alternative is $34,000,000. Table B4.12-13a details the costing for this alternative.

16.2.4 Alternative 19a/B11a/A4: In Situ Thermal Treatment

Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating), paired with Alternatives B11a: In Situ Thermal Treatment (RF/Microwave Heating) and A4: Incineration/Pyrolysis (Rotary Kiln), treats 200,000 BCY of contaminated soils. Prior to in situ

thermal treatment of the soils, 34,000 SY of soils with potential agent presence are screened by analyzing soil cores from exploratory drilling with real-time field analytical methods. When it is verified that there is no agent present, the soils are treated by RF heating. If it is verified that agent is present, the agent-contaminated soils are treated by rotary kiln incineration. It is estimated that 90 BCY of the soils in for this subgroup contain agent. Operating parameters of the incinerator include an operating temperature of 760°F, a residence time of 66 minutes, and a processing rate of 474 BCY/day. (Section 4.6.26 discusses emission controls for off gases generated by the incinerator.) Approximately 1 percent of the soils feed is entrained in the off-gas stream and recovered in the scrubber blowdown. The recovered particulates, 1 BCY, are placed in an on-post hazardous waste landfill due to high inorganic concentrations and salts. The treated soils are then returned to the site as backfill.

Two years prior to treatment, a dewatering system is installed to lower the water table prior to and during excavation activities. Groundwater removed at 0.2 gpm during dewatering is pumped to the CERCLA Wastewater Treatment Plant. To control odor emissions, minimal area is exposed to the atmosphere at any one time, and daily soil covers or plastic liners are placed over the excavated areas to further control odor emissions.

Human health and biota exceedances not containing agent are treated by RF heating. RF heating mobilizes the organic contaminants by raising the temperature of the soil to more than 250°C. The mobilized contaminants are collected and treated in the off-gas treatment system as discussed in Section 4.6.29. One RF unit is used for the Section 36 Lime Basins Subgroup. The unit treats a block of soil with contaminants to a depth of 10 ft and a moisture content of 20 percent at a rate of approximately 130 BCY/day. The treated block of soil has approximate dimensions of 100 ft long by 48 ft wide and 10 ft deep. The liquid sidestream generated by RF heating, which contains predominantly salts, is transported to the thermal desorption facility for treatment in the evaporator with the scrubber effluent sidestream. A 6-inch layer of topsoil is placed over the treated human health and biota exceedance areas of 63,000 SY to provide a medium for

vegetation. The treated area is then revegetated with native grasses to improve the habitat quality of the site.

Table 16.2-4 presents an evaluation of Alternative 19a against the EPA criteria for the DAA. RF heating theoretically achieves Human Health and Biota RAOs with low residual risk since all OCPs and volatile metals can be driven from the soils by this form of in situ thermal treatment. However, based on the 97 to 99.9 percent DRE achieved during the pilot-scale test, the RF heating technology failed to confirm the temperature distribution and OCP removal required for confident treatment of soils to achieve PRGs. The technology generally treats to achieve Human Health PRGs, since the residual levels of OCP contamination are anticipated to be within the acceptable risk range for human health (10^{-6} to 10^{-4} excess cancer risk), but the residual OCP levels are anticipated to be more than the Biota PRGs. The treated areas are revegetated to improve habitat, but some biota risk remains due to the failure to achieve PRGs. The implementability of in situ RF heating is questionable since there is no commercial source for the equipment and the technique is as yet unproven at full scale. The treatment of 200,000 BCY of contaminated soils is feasible within 5 years. The total estimated present worth cost of this alternative is $86,000,000. Table B4.12-19a details the costing for this alternative.

16.3 SECTION 36 LIME BASINS SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Section 36 Lime Basins Subgroup contains 200,000 BCY of exceedance volume contaminated with OCPs, arsenic, and mercury. These basins were used to treat wastewater from manufacturing operations and from the demilitarization of lewisite. Between 0 and 15 percent of the individual OCP samples are above the Human Health SEC, and 0 to 32 percent of individual OCP samples exceed the Biota SEC only (Table 16.1-2). The human health risk is moderate since the average OCP concentrations in the human health exceedance volume are above the Human Health SEC. Average OCP concentrations in soils exceeding the Biota and Human Health SEC are substantially higher than the Biota SEC; average arsenic and mercury concentrations in this volume are also above the Biota SEC (Table 16.1-1).

Less than 2 percent of the aldrin, dieldrin, and chlordane samples exceed the principal threat criteria for these compounds, resulting in a principal threat volume (including overburden) of 19,000 BCY for the subgroup (Table 16.1-2). In addition, 34,000 SY are also potentially contaminated with agent since lewisite was demilitarized on site.

This subgroup has poor-quality habitat based on the vegetation present at the site. Alternatives that disrupt habitat include revegetation and restoration activities following remediation. No significant habitat impacts are anticipated, although alternatives that involve containment with a cap/cover require the exclusion of burrowing animals.

As part of the Lime Basins IRA, contaminated soils and sludges from outside the basin were consolidated within the center of the site, and compacted soil and a layer of topsoil were placed over the top to reduce infiltration and groundwater contamination identified as originating from the site. Construction of a slurry wall was abandoned when munitions casings were found during excavation operations. The soil cap reduces the potential for exposures to humans, but does not protect biota and groundwater over the long term.

Before the exceedance soils are excavated at this site, the soils are sampled to identify agent presence, an activity that requires health and safety protection for site workers. In addition, to reduce odor emissions, minimal area is exposed to the atmosphere at any one time, and a daily cover or plastic liner is used to further reduce odor emissions.

In summary, this subgroup contains soils that exceed Human Health and Biota SEC, and has limited areas where there are high OCP concentrations that exceed principal threat criteria. The existing soil cap limits exposure pathways, but contaminants may still leach to groundwater. In selecting the preferred alternative for this subgroup, the short-term risks of worker exposure and community impacts from the potential release of vapors must be weighed against the longer-term risks of leaving the contamination in place.

Alternative 1: No Additional Action is protective of human health through the existing soil cap, but biota protection and long-term groundwater protection are not achieved. Therefore, this alternative is eliminated from further consideration as the preferred alternative. The remaining three alternatives involve treatment that achieves RAOs, are protective of human health and the environment, and comply with action- and location-specific ARARs.

Alternative 19a: In Situ Thermal Treatment achieves RAOs through treatment as contaminant concentrations generally achieve Human Health PRGs based on 10^{-6} excess cancer risk, which is the point of departure for treatment. The residual risk following treatment is within the acceptable human health risk range of 10^{-4} to 10^{-6}, but does not achieve Biota PRGs. Moreover, RF heating is not proven at full scale, nor is the equipment available at full scale.

Alternative 6d: Caps/Covers with Modifications to Existing System achieves RAOs through containment, although contaminated soils remain in place. Alternative 13a: Direct Thermal Desorption requires the excavation of 42,210 BCY of overburden and treatment of 200,000 BCY of contaminated soils, so it is much more costly than the containment alternative ($34,000,000 versus $4,900,000).

The preferred alternative for the Section 36 Lime Basins Subgroup is Alternative 6d: Caps/Covers with Modifications to Existing System. This alternative is the most cost-effective alternative since the existing containment system is augmented. Because no material is excavated, there are fewer short-term impacts on the habitat with this alternative and risks to site workers and the community are minimized. The long-term performance of the existing cap is improved with the additional clay layer, so this alternative will enhance the effectiveness of the preferred alternative for the Basin A Plume Group in the water medium, Alternative AC-3/AT-2, by reducing groundwater recharge.

16.4 BURIED M-1 PITS SUBGROUP CHARACTERISTICS

The Buried M-1 Pits Subgroup consists of site SPSA-1e (Buried M-1 Pits) (Figure 16.0-1). The pits were used to treat waste fluids from the lewisite facility. However, waste materials from alleged spills within the acetylene generation building, the thionylchloride plant, and the arsenic trichloride plant were allegedly routed through floor drains and the connecting piping to the pits. The pits were primarily used to precipitate arsenic out of solution. In addition, a considerable amount of mercuric chloride catalyst from a possible spill entered the pits. The pits were backfilled in 1947 and are now covered with several feet of soil and several structures. For this subgroup, the entire 8,600 SY of the site exceed the principal threat criteria and, based on the history of the site, exhibit the potential presence of agent.

Table 16.4-1 provides a summary of contaminants, exceedance volume concentrations, and corresponding exceedance values for this subgroup, and Table 16.4-2 summarizes detections for samples taken in this subgroup. Maximum concentrations of OCPs, HCCPD, DPCD, arsenic, cadmium, and mercury exceed the Human Health SEC in 29,000 BCY throughout the 10-ft depth interval. Less than 5 percent of the samples for any individual organic COC exceed the Human Health SEC; arsenic has the highest proportion of samples exceeding Human Health SEC (28.9 percent). Average concentrations of only arsenic and mercury within the human health exceedance volume actually exceed the Human Health SEC. Figure 16.4-2 presents the overlap between potential agent presence areas and the human health exceedance areas. Maximum concentrations of endrin, p,p,DDE, and p,p,DDT exceed the Biota SEC; however, the biota exceedances are included in the human health exceedance area, which encompasses most of the site. Figure 16.4-1 shows the distribution of exceedance areas for the subgroup and Table 16.0-1 presents the exceedance volumes.

The Buried M-1 Pits Subgroup contains poor-quality habitat based on the vegetation types encountered at the site. The areas disturbed during remedial actions are revegetated with native grasses or are covered with a cap related to the remediation of other South Plants soils or

groundwater, improving the overall habitat value. However, burrowing animals are excluded from areas involving the containment of the site through the installation of a cap/cover.

This subgroup is identified as the source of a groundwater contamination plume occurring in the unconfined aquifer in conjunction with the South Plants North Plume and the Basin A Plume Group. The Basin A Plume follows the Basin A Neck paleochannel to the northwest where it is intercepted and treated by the Basin A Neck IRA treatment system. Groundwater alternatives that address improved performance for the Basin A Neck IRA treatment system or mass reduction of individual plume groups are being evaluated. Coordination of alternatives developed for the soils medium with those developed for the water medium is necessary for alternatives involving hydraulic controls or dewatering. Due to the contaminant mass loading already in the aquifer, it is unlikely that the remediation of the Buried M-1 Pits would result in the shutdown of the Basin A Neck IRA treatment system.

16.5 EVALUATION OF ALTERNATIVES

The alternatives for the Buried M-1 Pits Subgroup vary in approach from no action to treatment. The range of alternatives retained in the DSA was modified by the addition of a containment alternative (Alternative 5), which was added since the IRA for the M-1 pits has not yet been initiated. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedances (which is listed first) and an alternative to address areas with the potential presence of agent (the "A" alternative).

16.5.1 Alternative 1/A1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative A1: No Additional Action (Provisions of FFA), applies to all 8,600 SY of exceedance area in the Buried M-1 Pits Subgroup. The 29,000 BCY of soils with human health and potential agent exceedance volume remain in place. No action is taken to reduce human or biota exposure to COCs, to prevent acute chemical hazards from agent, or to reduce migration of contaminants to

groundwater. This alternative complies with provisions of the FFA. Exceedance areas are monitored (an average of 7 samples per year) and 5-year site reviews are conducted to assess potential migration of contaminants.

Table 16.5-1 evaluates the alternative against the EPA criteria for the DAA. RAOs are not achieved under this alternative as untreated soils remain in place without adequate controls. The residual risk is only moderate as the relatively high levels of contamination are found at depth. The poor-quality habitat at the site is not changed and the impacts on groundwater quality are not reduced. Costs associated with soil monitoring and site reviews result in a total estimated present worth cost of $570,000. Table B4.13-1 details the costing for this alternative.

16.5.2 Alternative 5/A2: Caps/Covers; Vertical Barriers

Alternatives 5: Caps/Covers (Clay/Soil Caps); Vertical Barriers (Slurry Walls), along with Alternative A2: Caps/Covers (Clay/Soil Cap), contains 29,000 BCY of principal threat exceedance volume by installing 8,600 SY of clay/soil cap and 2,500 SY of slurry wall. The areas that potentially contain agent are contained by this cap, interrupting human exposure pathways. A soil/bentonite slurry wall, as described in Section 4.6.8 of the Technology Description Volume, is installed around the perimeter of the site (1,200 linear ft) into competent bedrock (approximately 19 ft below grade). The soils excavated from the slurry wall trench are potentially contaminated and are therefore graded over the surface of the isolation cell to be included under the cap. Though not required based on present groundwater elevations, a dewatering system is installed as a contingency to ensure a reduced hydraulic head within the cell, minimizing the potential for further groundwater contamination. Groundwater removed by this system is pumped to the CERCLA Wastewater Treatment Plant. Depending on the pumping rate and contaminant concentrations, pre-treatment may be required or the water may be sent off post for treatment.

Following slurry wall installation, the clay/soil cap is constructed. The subgrade is compacted before any cover materials are installed and the surface is crowned to facilitate surface-water

runoff. The area is then covered by a 2-ft layer of compacted low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. This cap may be part of a larger cap covering the South Plants Central Processing Area (see Section 17.2). Revegetation of the topsoil with native grasses completes the remedial action. The cover provides a physical barrier protecting human and biota receptors from directly contacting the contaminated soils. The fill materials used for cap and slurry wall construction are excavated from an on-post borrow area, while the topsoil is obtained off post. After completion of the alternative, the borrow area is recontoured and the habitat is restored through revegetation. Maintenance activities and restrictions to burrowing animals ensure the continued integrity of the clay/soil cover and continued operation of the dewatering system.

Table 16.5-2 evaluates the alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs through containment and reduces the potential for migration of contaminants to groundwater. The impact to biota is minimal due to the existing poor-quality habitat. Installation of the slurry wall and clay/soil cap takes less than 1 year to complete, but long-term maintenance is required to ensure the integrity of the cap and dewatering system. The total estimated present worth cost of this alternative is $2,200,000. Table B4.13-5 details the costing for this alternative.

16.5.3 Alternative 10/A4: Direct Solidification/Stabilization

Alternative 10: Direct Solidification/Stabilization (Cement-Based Solidification), along with Alternative A4: Incineration/Pyrolysis (Rotary Kiln), treats 29,000 BCY of contaminated soils by solidification. The predominant COCs in this subgroup are inorganics that are amenable to solidification. Based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed, dewatering for worker safety during excavation is not required. During excavation, a limited area is exposed at any one time to reduce odor emissions and daily soil covers or plastic liners are placed over the excavated areas to further control odor releases.

During excavation, 8,600 SY of soils are screened for agent and any soils identified as containing agent are treated by rotary kiln incineration. It is estimated that there are 29 BCY of agent-contaminated soils in this subgroup. Operating parameters of the incinerator include an operating temperature of 760°C, a residence time of 66 minutes, and a processing rate of approximately 470 BCY/day. Off gases associated with the incinerator are treated as discussed in Section 4.6. Approximately 1 percent of the soils feed is entrained in the off-gas stream and recovered in the scrubber blowdown. The recovered particulates, 1 BCY, are placed in the on-post hazardous waste landfill due to high inorganic concentrations and salts. The treated soils are then returned to the site for further treatment, if necessary.

As described in Section 4.6.22, the 29,000 BCY of exceedance soils are excavated and solidified using a portable pug mill capable of treating 46 BCY/day. The contaminated soils are solidified by adding cement as a binder at a 20-percent ratio to immobilize arsenic, mercury, and ICP metals in the soils. As a result of excavation and solidification, the volume of contaminated soils increases by 20 percent, which results in a total solidified volume of 35,000 BCY. The solidified soils are placed in the site excavations and covered with 4 ft of borrow soils obtained on post and topsoil obtained off post. Due to the volume expansion from solidification, the cover is crowned, which aids in the control of surface water. The soil cover ensures the integrity of the solidified materials and prevents freeze/thaw degradation of the materials. The soils may be capped as part of the remediation of the South Plants Central Processing Area (see Section 17.2). The cover is revegetated to improve habitat quality at the site. A total of 8,600 SY of backfilled area is revegetated.

Table 16.5-3 evaluates the alternative against the EPA criteria for the DAA. This alternative achieves human health RAOs since all contaminated soils are treated, immobilizing the exceedance COCs. The habitat is improved at the site. Solidification of 29,000 BCY of soils takes less than 3 years, but the construction and testing of the incinerator for agent treatment requires 2 years before the soils are processed. The total estimated present worth cost of this alternative is $4,300,000. Table B4.13-10 details the costing for this alternative.

16.5.4 Alternative 19/A4: In Situ Thermal Treatment; In Situ Solidification/Stabilization

Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification), combined with Alternative A4: Incineration/Pyrolysis (Rotary Kiln), addresses 29,000 BCY of human health exceedance soils. Since the entire Buried M-1 Pits Subgroup potentially contains agent, soil cores from drilling are analyzed in the field to identify agent-contaminated soils before the in situ treatment begins. It is estimated that there are 29 BCY of agent-contaminated soils in this subgroup. If soils are confirmed by screening to contain agent, they are treated by excavation and incineration. During excavation, minimal area is exposed at any one time to reduce odor emissions, and daily soil covers or plastic liners are placed over the excavated areas to further control odor releases. Operating parameters of the incinerator include an operating temperature of 760°F, a residence time of 66 minutes, and a processing rate of approximately 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases associated with the incinerator.) Approximately 1 percent of the soils feed is entrained in the off-gas stream and is recovered in the scrubber blowdown. The recovered particulates, 1 BCY, are placed in an on-post hazardous waste landfill due to their high inorganic concentrations and salts. The treated soils are then returned to the site for further treatment, if necessary.

RF heating raises the temperature of the soil to more than 250°C, which mobilizes the organic contaminants. The mobilized contaminants are then collected and treated in the off-gas treatment system as described in Section 4.6.29. One RF unit is used to treat 2,300 BCY of soil containing organic exceedances at a processing rate of approximately 130 BCY/day. The unit can treat a contaminated block of soil that is 10 ft deep and has a moisture content of 20 percent. The treated block is approximately 100 ft long by 48 ft wide. The liquid sidestream, which contains predominantly salts, is transported to the thermal desorption facility for treatment along with the scrubber effluent sidestream. RF heating only treats the organic contaminants, so soil containing inorganic exceedances is addressed through in situ cement-based solidification. The human health inorganic volume of 29,000 BCY is solidified using a transportable track-mounted boring/mixing unit and a cement batch plant capable of processing 600 BCY/day. Portland

cement is mixed with excavated soils at a ratio of 0.2 ton of cement per ton of soil. Upon solidification, the soil swells approximately 20 percent due to the incorporation of the cement. Borrow soil from the on-post borrow area and topsoil obtained off post are recontoured over the solidified soil (8,600 SY) and revegetated with native grasses to improve the habitat quality of the site. The soil cover ensures the integrity of the solidified soils and prevents freeze/thaw degradation of the materials. The soils may also be capped as part of the remediation of the South Plants Central Processing Area (see Section 17.2).

Table 16.5-4 evaluates the alternative against the EPA criteria for the DAA. RF heating theoretically achieves Human Health RAOs with low residual risk since all OCPs and volatile metals are driven from the soil by this form of in situ thermal treatment. However, based on the 97 to 99.9 percent DRE achieved during the RMA pilot-scale test, the RF heating technology failed to confirm the temperature distribution and OCP removal required for confident treatment of soils to achieve PRGs. The technology generally achieves Human Health PRGs, since the residual levels of OCP contamination are anticipated to be within the acceptable risk range for human health (10^{-6} to 10^{-4} excess cancer risk), but residual levels of some contaminants exceed Biota PRGs. The treated areas are revegetated to improve the habitat. The implementability of in situ RF heating is questionable since there is no commercial source for the equipment and the techniques are as yet unproven at full scale. In situ treatment of the site is feasible within 3 years, including the 2 years required for construction and testing of the incinerator for agent treatment. The total estimated present worth cost of this alternative is $16,000,000. Table B4.13-19 details the costing for this alternative.

16.5.5 Alternative 21/A1: In Situ Thermal Treatment

Alternatives 21: In Situ Thermal Treatment (In Situ Vitrification), along with Alternative A1: No Additional Action (Provisions of FFA), addresses 29,000 BCY of contaminated soils. In situ vitrification uses electricity passed through electrodes into the soils to melt the contaminated soil into a vitreous mass. The majority of organic contaminants are destroyed by pyrolysis at a temperature of 3,000°C, with a small fraction being bound up in the melt mass and another

fraction being driven off and captured in the off-gas treatment system (Section 4.6.33). The majority of inorganic contaminants are stabilized in the melt mass, with a fraction of the more volatile inorganic contaminants, such as mercury, being driven off and captured in the off-gas treatment system.

Three sidestreams are generated including wastewater, treated off gas, and spent carbon from the off-gas treatment system. The wastewater is transferred to an on-post water treatment facility. The spent carbon is regenerated and the off gas is treated as described in Section 4.6.33. The vitrified mass is left in place. Residual contaminants in the vitrified mass are immobilized and cannot migrate out of the mass. Since in situ vitrification results in a reduction of the soil volume by approximately 45 percent, 13,050 BCY of borrow material from the on-post borrow area are used to bring the site to grade. Six inches of topsoil is then placed over the treated area of 8,600 SY and revegetated to improve the habitat of the site. After completion of the alternative, the borrow site is recontoured and revegetated to restore the habitat. The soils may also be capped as part of the remediation of the South Plants Central Processing Area (see Section 17.2).

Table 16.5-5 evaluates the alternative against the EPA criteria for the DAA. This alternative achieves RAOs through treatment. It complies with both action-specific and location-specific ARARs. The soils with potential agent presence are thermally treated by vitrification at an adequate temperature (3,000°C), but in situ vitrification is not an approved technology according to Army regulations, which may require a variance from the regulations. The habitat is improved through revegetation of the vitrified area with native grasses. Vitrification of 29,000 BCY of soils takes a total of 2 years. The total estimated present worth cost of this alternative is $41,000,000. Table B4.13-21 details the costing for this alternative.

16.6 BURIED M-1 PITS SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Buried M-1 Pits Subgroup contains 29,000 BCY of exceedance soils. The pits were used to treat waste fluids form the lewisite facility and were possibly used to treat spills from

surrounding buildings. The pits were backfilled and are now covered with several feet of soils and several structures. Maximum concentrations of OCPS, HCCPD, DPCD, arsenic, cadmium, and mercury exceed Human Health SEC. Less than 3 percent of the samples for any individual OCP exceed Human Health SEC but between 20 and 30 percent of the arsenic and mercury samples exceeded the Human Health SEC. Average concentrations of COCs in the human health exceedance volume are below the Human Health SEC, except for arsenic and mercury which substantially exceed the Human Health SEC.

Nineteen percent of the arsenic samples exceed the principal threat criteria, producing an exceedance area that encompasses the entire site. The entire site also has the potential for agent contamination based on the historical usage and has been identified as the source of a groundwater contamination plume.

This subgroup has poor-quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration following remediation. No significant habitat impacts are expected, although alternatives that involve caps/covers require the exclusion of burrowing animals.

Before the exceedance soils are excavated at this site, the soils are sampled to identify agent presence, and activity that requires health and safety protection for site workers. To reduce odor emissions, minimal area is exposed to the atmosphere at any on time, and a daily soil cover or plastic liner is used to prevent odor emissions.

In summary, this subgroup contains soils that exceed Human Health SEC, and has an area of principal threat exceedances with high arsenic and mercury concentrations that encompasses the entire site. In selecting the preferred alternative for this subgroup, the short-term risks of worker exposure and community impacts from the potential release of vapors must be weighed against the longer-term risks of contaminant migration if contaminants are left in place.

Alternative 1: No Additional Action does not achieve RAOs as sludges or soils with high levels of contamination and the potential presence of agent are left in place without treatment or controls. This alternative is eliminated from further consideration in the selection of the preferred alternative. The remaining four alternatives achieve RAOs, are protective of human health and the environment, and comply with action- and location-specific ARARs.

Alternative 19: In Situ Thermal Treatment; In Situ Solidification/Stabilization achieves RAOs through treatment, and generally reduces the organic contaminant concentrations to PRGs based on 10^{-6} excess cancer risk, which is the point of departure for treatment. However, although residual levels of contaminants are within the acceptable range for human health excess cancer risk, Biota PRGs are not met for some contaminants. Furthermore, RF heating equipment is unavailable and unproven at full scale. The cost for this alternative ($16,000,000) is higher than for Alternative 10: Direct Solidification/Stabilization ($4,300,00). Alternative 21: In Situ Thermal Treatment has the highest cost ($41,000,000) of the alternatives for this subgroup. In addition, the technology for this alternative is not well demonstrated at full scale, nor is a vendor currently available to provide equipment for full-scale operation. Alternative 5: Caps/Covers; Vertical Barriers is readily implemented and has a moderate cost ($2,200,000), but does not treat the contaminated material. This alternative entails long-term operation of the dewatering system and maintenance of the clay/soil cap. Alternative 10: Direct Solidification/Stabilization has the lowest cost of the treatment alternatives ($4,300,000) and treats the entire volume of contaminated material. Based on treatability studies (Section 4.5.22), the mobility of both arsenic and mercury are reduced between 90 and 99 percent, indicating effective immobilization of the contaminants. Long-term monitoring is required to maintain the durability of the solidified materials.

The preferred alternative for the Buried M-1 Pits Subgroup is Alternative 10: Direct Solidification/Stabilization. This alternative is consistent with NCP guidance on treatment of higher-level concentrations and provides better controls than the installation of a cap/cover

without treatment. The technology is readily available and implementable, and is the most cost-effective alternative for this subgroup.

Table 16.0-1 Characteristics of the Lime Basins Medium Group

Characteristic	Section 36 Lime Basins Subgroup	Buried M-1 Pits Subgroup
<u>Contaminants of Concern</u>		
Human Health	OCPs	OCPs, ICP metals, As, Hg
Biota	OCPs, As, Hg	not applicable
<u>Exceedance Area (SY)</u>		
Total	63,000	8,600
Human Health	52,000	8,600
Biota	11,000	not applicable
Potential Agent	34,000	8,600
Potential UXO	not applicable	not applicable
<u>Exceedance Volume (BCY)</u>		
Total	200,000	29,000
Human Health	110,000	29,000
Organic	110,000	2,300
Inorganic	not applicable	29,000
Principal Threat	19,000	29,000
Biota	93,000	not applicable
Potential Agent	90	29
Potential UXO	not applicable	not applicable
<u>Depth of Contamination (ft)</u>		
Human Health	0-8	0-10
Biota	0-8	0

Table 16.1-1 Summary of Concentrations for the Section 36 Lime Basins Subgroup

Contaminants of Concern	Range of Concentrations[2] (ppm)	Average Concentration[2] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–3,300	160	56	560	0.68
Dieldrin	BCRL–1,500	73	40	400	0.83
Endrin	BCRL–750	31	15	15,000	0.029
Isodrin	BCRL–500	32	3.4	3,400	–
Chlordane	BCRL–470	11	3.1	260	–
p,p,DDE[1]	BCRL–20	1	130	1,300	0.2
p,p,DDT[1]	BCRL–5.2	0.2	26	1,300	1.4
Arsenic[1]	BCRL–530	45	530	5,300	16.5
Mercury[1]	BCRL–82	3.3	470	470,000	0.99
Biota Exceedance Volume					
Aldrin	BCRL–39	2.4	56	560	0.68
Dieldrin	BCRL–24	2.3	40	400	0.83
Endrin	BCRL–7.5	0.56	15	15,000	0.029
p,p,DDE	BCRL–5.1	0.28	130	1,300	0.2
p,p,DDT	BCRL–1.8	0.14	26	1,300	1.4
Arsenic	BCRL–301	44	530	5,300	16.5
Mercury	BCRL–11	0.95	470	470,000	0.99

1 Present above Biota SEC only, but was detected in the human health exceedance volume.
2 Based on modeled concentrations within exceedance volume.
BCRL Below Certified Reporting Limit
ppm Parts Per Million
SEC Site Evaluation Criteria
– Not Applicable

Table 16.1-2 Frequency of Detections for Section 36 Lime Basins

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	120	73	60.8%	11	9.2%	21	17.5%	13	10.8%	2	1.7%
Benzene	45	39	86.7%	6	13.3%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	45	45	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	120	108	90.0%	6	5.0%	--	--	5	4.2%	1	0.8%
Chloroacetic Acid	9	9	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	45	43	95.6%	2	4.4%	--	--	0	0.0%	0	0.0%
Chloroform	45	34	75.6%	11	24.4%	--	--	0	0.0%	0	0.0%
p,p,DDE	120	98	81.7%	11	9.2%	11	9.2%	0	0.0%	0	0.0%
p,p,DDT	120	105	87.5%	13	10.8%	2	1.7%	0	0.0%	0	0.0%
Dibromochloropropane	118	113	95.8%	5	4.2%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	45	45	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	21	21	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	118	112	94.9%	6	5.1%	--	--	0	0.0%	0	0.0%
Dieldrin	120	53	44.2%	22	18.3%	38	31.7%	5	4.2%	2	1.7%
Endrin	120	76	63.3%	8	6.7%	28	23.3%	8	6.7%	0	0.0%
Hexachlorocyclopentadiene	120	110	91.7%	9	7.5%	--	--	0	0.0%	0	0.0%
Isodrin	120	83	69.2%	20	16.7%	--	--	17	14.2%	0	0.0%
Methylene Chloride	40	37	92.5%	3	7.5%	--	--	0	0.0%	0	0.0%
Tetrachloroethane	8	8	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	45	42	93.3%	3	6.7%	--	--	0	0.0%	0	0.0%
Toluene	45	44	97.8%	1	2.2%	--	--	0	0.0%	0	0.0%
Trichloroethylene	45	44	97.8%	1	2.2%	--	--	0	0.0%	0	0.0%
Arsenic	117	53	45.3%	39	33.3%	24	20.5%	1	0.9%	0	0.0%
Cadmium	101	84	83.2%	17	16.8%	--	--	0	0.0%	0	0.0%
Chromium	101	46	45.5%	55	54.5%	--	--	0	0.0%	0	0.0%
Lead	101	70	69.3%	31	30.7%	--	--	0	0.0%	0	0.0%
Mercury	118	53	44.9%	58	49.2%	7	5.9%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 16.2-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for the Section 36 Lime Basins Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Partially achieves Human Health and Biota RAOs as untreated soils remain but are contained by existing IRA soil cover; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Lime Basins Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. OCPs above Human Health SEC, and OCPs, arsenic, and mercury above Biota SEC remain in soil; potential presence of agent remains.
b) Adequacy and reliability of controls	b) No controls beyond existing IRA implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility beyond existing soil cap; 200,000 BCY of untreated soils remain; no reduction in potential hazards for agent presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personal protective equipment adequately protects workers during maintenance operations.
b) Protection of community during remedial action	b) Protective of community. No fugitive dust or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Potential agent remains on site.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $1,650,000
d) Total	d) $1,650,000

Table 16.2-2 Evaluation of Alternative 6d: Caps/Covers (Clay/Soil Cap) with Modifications to Existing system; Alternative 5b: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers Clay/Soil Cap) for the Section 36 Lime Basins

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained through augmentation of clay/soil cap and installation of dewatering system, preventing human and biota exposure; groundwater impact reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Lime Basins Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. Containment of untreated soils augmented through installation of clay/soils cap and dewatering.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soil; erosion control, vegetative cover, and dewatering system maintenance required; high confidence in engineering controls of clay/soil cap and dewatering system.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during revegetation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) Exposure pathways interrupted and mobility of containments reduced through enhancement of 63,000-SY clay/soil cap, and installation of dewatering system; soils with agent contained with clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap degrades or leaks.
d) Type and quantity of treatment residuals	d) Groundwater removed by dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of cap and dewatering.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by spraying water; odor and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 1 year. Modification of 63,000-SY clay/soil cap and associated dewatering system feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; dewatering required; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily available. Equipment, specialists, and materials readily available for clay/soil cap and dewatering system; clay/soil cap and dewatering system well demonstrated at full scale.

Table 16.2-2 Evaluation of Alternative 6d: Caps/Covers (Clay/Soil Cap) with Modifications to Existing system; Alternative 5b: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers Clay/Soil Cap) for the Section 36 Lime Basins

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $3,100,000
b) Long-term	c) $1,800,000
c) Total	d) $4,900,000

Table 16.2-3 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Section 36 Lime Basins Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to OCPs detection levels and inorganics reduced below Biota SEC; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, A-11, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Lime Basins Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 200,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during revegetation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 200,000 BCY thermally desorbed to degrade OCPs and remove mercury; soils with agent identified and treated.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; arsenic reduced below Biota SEC following solids blending as a pretreatment and limited volatization during thermal desorption (20% to 30%); scrubber blowdown solids from off-gas treatment equipment with mercury, arsenic, and salts placed in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 2,000 BCY of blowdown solids with arsenic, mercury, and salts landfilled; groundwater removed at 0.2 gpm by dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent clearance, dewatering, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 200,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility, incinerator for agent treatment, and landfill.

Table 16.2-3 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Section 36 Lime Basins Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitored; dewatering required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth cost	
a) Capital	a) $5,600,000
b) Operating	b) $28,000,000
b) Long-term	c) $8,000
c) Total	d) $34,000,000

Table 16.2-4 Evaluation of Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Section 36 Lime Basins Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment, and concentrations generally reduced to achieve Human Health PRGs for point of departure, but Biota PRGs not achieved; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-13, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Lime Basins Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 200,000 BCY thermally treated in place but Biota PRGs not achieved; Human Health PRGs generally achieved and residual levels of OCPs levels within acceptable levels for human health (10^{-4} to 10^{-6} excess cancer risk); arsenic above Biota PRGs remains in soil.
b) Adequacy and reliability of controls	b) Controls not required. Monitoring of treated soils not required.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed area improves existing poor-quality habitat, but some biota risk remains as Biota PRGs not achieved.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 200,000 BCY thermally treated to degrade OCPs and some mercury removed; soils with agent identified and treated.
b) Degree and quantity of TMV reduction	b) Reductions from RF heating (97-99.9% destruction removal efficiency) unable to achieve Biota PRGs. OCP levels in treated soils within acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk); mercury condensed in blowdown liquid.
c) Irreversibility of TMV reduction	c) TMV reduction by in situ RF heating irreversible.
d) Type and quantity of treatment residuals	d) Liquid blowdown sidestream with elevated mercury, arsenic, and salts treated at thermal desorption facility along with scrubber effluent; groundwater removed at 0.2 gpm from dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers: Personnel protective equipment adequately protects workers during in situ heating, dewatering, and agent screening.
b) Protection of community during remedial action	b) Protective of community. No fugitive dust emissions; vapor emissions associated with RF heating unit controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 5 years. RF treatment of 200,000 BCY feasible within 5 years; incineration of agent feasible within 1 year after 2 years for construction of incinerator facility.

Table 16.2-4 Evaluation of Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Section 36 Lime Basins Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of RF heating on soil with similar contaminants but unproven at full scale; additional remedial actions easily undertaken for treated soils that do not achieve PRGs; dewatering required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of thermal treatment unit siting, design, and operating regulations.
c) Availability of services and materials	c) Limited availability. Equipment custom designed for each application and not available; specialists only available through process licensor IITRI; no full-scale demonstration of RF equipment.
7. Present worth costs	
a) Capital	a) $13,000,000
b) Operating	b) $73,000,000
c) Long-term	c) $4
d) Total	d) $86,000,000

Table 16.4–1 Summary of Concentrations for the Buried M-1 Pits Subgroup

Contaminants of Concern	Range of Concentrations[2] (ppm)	Average Concentration[2] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–60	0.52	56	560	0.68
Dieldrin	BCRL–76	0.77	40	400	0.83
Isodrin	BCRL–9.1	0.074	3.4	3,400	–
HCCPD	BCRL–2,200	41	1,300	NA	–
DCPD	BCRL–6,800	190	1,200	NA	–
Cadmium	BCRL–3,800	260	480	66,000	–
Arsenic	27–100,000	17,000	530	5,300	16.5
Mercury	1.3–58,000	4,800	470	470,000	0.99
Endrin[1]	BCRL–1.5	0.024	15	15,000	0.029
p,p,DDE[1]	BCRL–1.3	0.017	130	1,300	0.20
p,p,DDT[1]	BCRL–2.7	0.031	26	1,300	1.4
Biota Exceedance Volume					
None	–	–	–	–	–

1 Present above Biota SEC only, but was detected in the human health exceedance volume.
2 Based on modeled concentrations within exceedance volume.
BCRL Below Certified Reporting Limit
DCPD Dicyclopentadiene
HCCPD Hexachlorocyclopentadiene
ppm Parts Per Million
SEC Site Evaluation Criteria
– Not Applicable

Table 16.4-2 Frequency of Detections for Buried M-1 Pits Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	75	66	88.0%	3	4.0%	5	6.7%	1	1.3%	0	0.0%
Benzene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	75	73	97.3%	2	2.7%	--	--	0	0.0%	0	0.0%
Chloroacetic Acid	29	24	82.8%	5	17.2%	--	--	0	0.0%	0	0.0%
Chlorobenzene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	75	73	97.3%	1	1.3%	1	1.3%	0	0.0%	0	0.0%
p,p,DDT	75	73	97.3%	1	1.3%	1	1.3%	0	0.0%	0	0.0%
Dibromochloropropane	77	77	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	6	6	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	82	59	72.0%	19	23.2%	--	--	4	4.9%	0	0.0%
Dieldrin	75	57	76.0%	7	9.3%	9	12.0%	1	1.3%	0	0.0%
Endrin	75	70	93.3%	2	2.7%	2	2.7%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	75	68	90.7%	6	8.0%	--	--	1	1.3%	0	0.0%
Isodrin	75	70	93.3%	3	4.0%	--	--	2	2.7%	0	0.0%
Methylene Chloride	40	34	85.0%	6	15.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethane	20	20	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Toluene	40	39	97.5%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	40	40	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	83	9	10.8%	20	24.1%	30	36.1%	5	6.0%	19	22.9%
Cadmium	44	21	47.7%	19	43.2%	--	--	4	9.1%	0	0.0%
Chromium	44	13	29.5%	31	70.5%	--	--	0	0.0%	0	0.0%
Lead	44	10	22.7%	34	77.3%	--	--	0	0.0%	0	0.0%
Mercury	83	14	16.9%	14	16.9%	37	44.6%	18	21.7%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 16.5-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain and controls are not implemented; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Buried M-1 Pits Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. OCPs, DCPD, arsenic, mercury, and ICP metals above Human Health SEC remain in soil; potential presence of agent remains.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility, 29,000 BCY of untreated soils remain; no reduction in potential hazards of agent presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environment impacts. Existing habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) RAOs not achieved as untreated soils remain in place without adequate controls; potential agent remain on site.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth cost	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $570,000
d) Total	d) $570,000

Table 16.5-2 Evaluation of Alternative 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Wall); Alternative A2: Caps/Covers (Soil Cover) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health SEC contained by clay/soil cap, slurry wall, and dewatering system, preventing human and biota exposure above Human Health SEC; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, and A-7)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Buried M-1 Pits Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 29,000 BCY of untreated soils contained through installation of 8,600-SY clay/soil cap, slurry wall, and dewatering system.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control, vegetative cover, slurry wall, and dewatering system maintenance required; high confidence in engineering controls of clay/soil cap and slurry wall.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 8,600-SY clay/soil cap, slurry wall, and dewatering system; soils with agent contained with clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap or slurry wall degrades or leaks.
d) Type and quantity of treatment residuals	d) Groundwater removed by dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of cap/cover and slurry wall, and during dewatering.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; burrowing animals excluded from area; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) One year. Installation of 8,600-SY clay/soil cap, slurry wall, and dewatering system feasible within 1 year.

Table 16.5-2 Evaluation of Alternative 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Wall); Alternative A2: Caps/Covers (Soil Cover) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; dewatering required; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover and slurry wall design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for clay/soil cap, slurry wall, and dewatering system; clay/soil caps, slurry walls, and dewatering system well demonstrated at full scale.
7. Present worth cost	
a) Capital	a) $1,200,000
b) Operating	b) $660,000
c) Long-term	c) $400,000
d) Total	d) $2,200,000

Table 16.5-3 Evaluation of Alternative 10: Direct Solidification/Stabilization (Cement-Based Solidification); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment/immobilization; contaminated soils solidified, preventing human exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-11, A-17, and A-18)	a) Complies with action-specific ARARs regarding monitoring of solidified material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Buried M-1 Pits Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 29,000 BCY solidified and returned to site as backfill.
b) Adequacy and reliability of controls	b) Adequate controls. Monitoring of solidified soils required; high confidence in immobilization of contaminants.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat. (Area may also be capped for remediation of South Plants Central Processing Area.)
4. Reduction in TMV	
a) Treatment process used and materials treated	a) Human exposure pathways interrupted and mobility of contaminants reduced by encapsulation of 29,000 BCY of soils; volume of solidified soils increased by 38% after bulking and expansion; soils with agent identified and treated.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) TMV reduction irreversible if integrity of solidified materials maintained.
d) Type and quantity of treatment residuals	d) 40,000 BCY of solidified soils backfilled and monitored.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent clearance, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 5 years. Solidification of 29,000 BCY feasible within 3 years after 2 years for construction of landfill and incinerator for agent treatment.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative implemented within required time frame; solidified soils monitored to ensure integrity.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system design and operation.
c) Availability of services and materials	c) Readily available. Equipment, specialists, and materials available from several vendors for solidification; solidification well demonstrated at full scale.

Table 16.5-3 Evaluation of Alternative 10: Direct Solidification/Stabilization (Cement-Based Solidification); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth cost	
a) Capital	a) $170,000
b) Operating	b) $3,900,000
c) Long-term	c) $210,000
d) Total	d) $4,300,000

Table 16.5-4 Evaluation of Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment, and concentrations reduced to generally achieve Human Health and Biota PRGs for point of departure; exposure pathways interrupted through solidification of contaminated soils; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-11, A-13, A-17, and A-19)	a) Complies with action-specific ARARs including state regulations on air emissions sources; solidified soils monitored; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Buried M-1 Pits Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 2,300 BCY thermally treated for OCPs but all Biota PRGs not achieved; Human Health PRGs generally achieved and reduction in residual OCP levels within acceptable levels for human health (10^{-4} to 10^{-6} excess cancer risk); 29,000 BCY solidified in place.
b) Adequacy and reliability of controls	b) Controls not required. Monitoring of solidified soils required.
c) Habitat improved	c) Habitat quality improved, but some biota risk remains as Biota PRGs not achieved. (Area may be capped for remediation of South Plants Central Processing Area.)
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 2,300 BCY thermally treated to degrade OCPs, remove mercury, and reduce arsenic; exposure pathways interrupted and mobility of contaminants reduced by solidification of 29,000 BCY of soils with inorganic contaminants; soils with agent identified and treated.
b) Degree and quantity of TMV reduction	b) Reductions from RF heating (97-99.9% destruction removal efficiency) unable to achieve all Biota PRGs. OCP levels in treated soils within acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk); mercury and arsenic condensed in blowdown liquid.
c) Irreversibility of TMV reduction	c) TMV reduction by RF heating irreversible; mobility reduction irreversible if integrity of solidified materials maintained.
d) Type and quantity of treatment residuals	d) Liquid blowdown sidestream with elevated inorganics and salts treated at thermal desorption facility with scrubber effluent; 29,000 BCY of solidified soils monitored.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent screening and in situ treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor emission controlled by limited excavation and daily soil covers or plastic liners; vapor emissions associated with RF heating unit controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. RF heating of 2,300 BCY and solidification of 29,000 BCY feasible within 1 year after 2 years for construction of incinerator for agent treatment.

Table 16.5-4 Evaluation of Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of RF heating on soil with similar contaminants but unproven at full scale; additional remedial actions easily undertaken for treated soils that do not achieve Biota PRGs; solidified soils monitored to ensure integrity.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system siting, design, and operating regulations.
c) Availability of services and materials	c) Limited availability. Equipment custom designed for each application and not available; specialists only available through process licensor ITRI; no full-scale demonstration of RF equipment; equipment, specialists, and materials available from several vendors for solidification; solidification well demonstrated at full scale.
7. Present worth cost	
a) Capital	a) $12,000,000
b) Operating	b) $4,000,000
c) Long-term	c) $220,000
d) Total	d) $16,000,000

Table 16.5-5 Evaluation of Alternative 21: In Situ Thermal Treatment (In Situ Vitrification); Alternative A1: No Additional Action (Provisions of FFA) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment/immobilization; contaminated soils vitrified, preventing exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-14)	a) Complies with action-specific ARARs regarding monitoring of vitrified material.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Buried M-1 Pits Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA, but does not exactly comply with Army regulations (AMC-R 385-131) regarding agent demilitarization as soils thermally treated through vitrification but not by approved method of incineration.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 29,000 BCY vitrified in place, reducing human health and biota exposure.
b) Adequacy and reliability of controls	b) Adequate controls. Monitoring of vitrified soils required.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of vitrified mass and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) Exposure pathways interrupted and mobility of contaminants reduced by vitrification of 29,000 BCY of contaminated soils; soils with potential agent treated by vitrification.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) TMV reduction by in situ vitrification irreversible.
d) Type and quantity of treatment residuals	d) 29,000 BCY of vitrified soils monitored in place.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during in situ treatment.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts; vapor emissions associated with vitrification controlled by air emissions control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impact. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 2 years. Vitrification of 29,000 BCY feasible within 2 years; soils with potential agent remain onsite.
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of vitrification on soils with similar contaminants but unproven at full scale; monitoring of vitrified soils to ensure integrity.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system operating regulations.
c) Availability of services and materials	c) Limited availability. Specialists only available through process licensor; no full-scale demonstration of vitrification equipment.

Table 16.5-5 Evaluation of Alternative 21: In Situ Thermal Treatment (In Situ Vitrification); Alternative A1: No Additional Action (Provisions of FFA) for the Buried M-1 Pits Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth cost	
a) Capital	a) $1,300,000
b) Operating	b) $39,000,000
c) Long-term	c) $540,000
d) Total	d) $41,000,000

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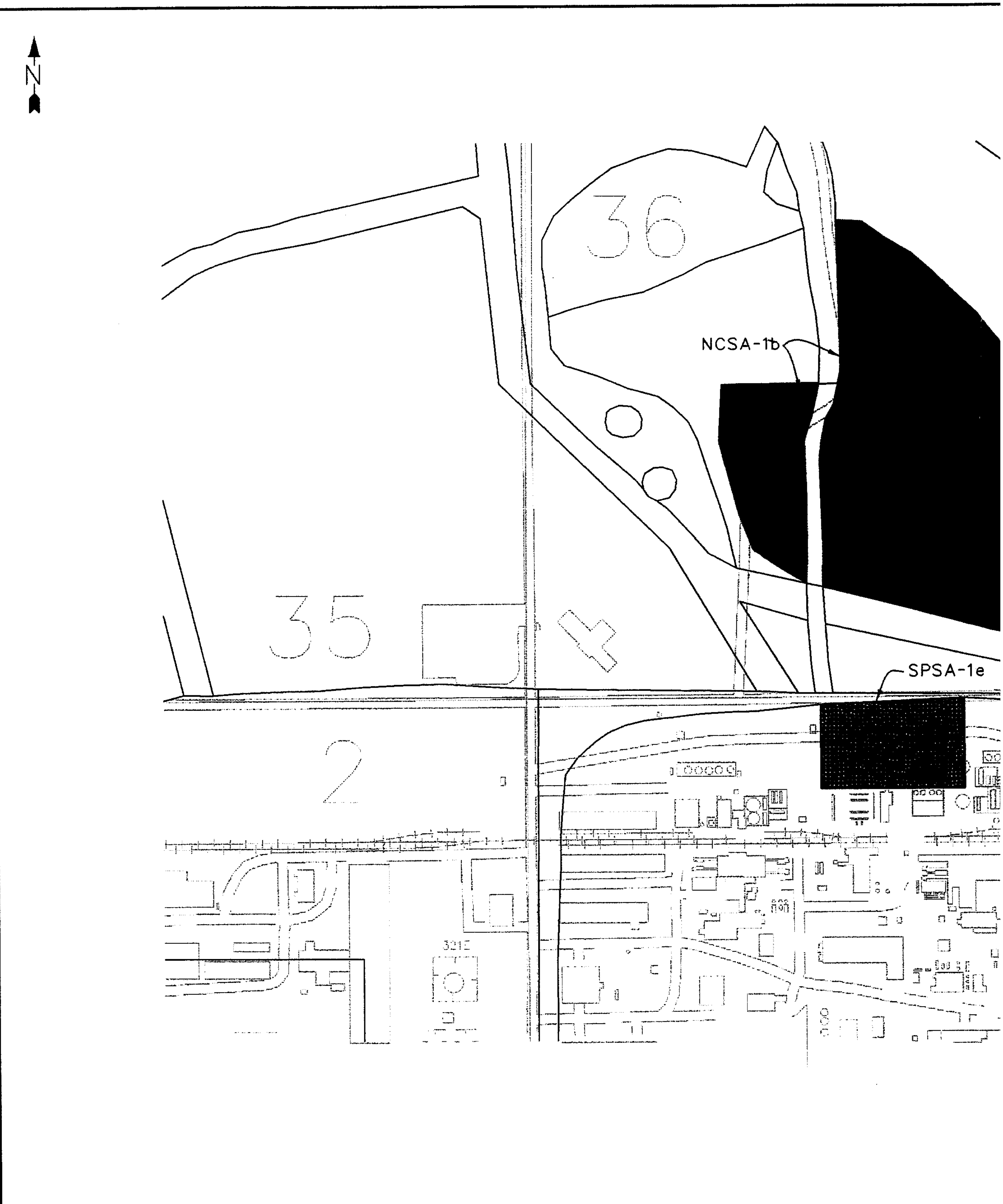
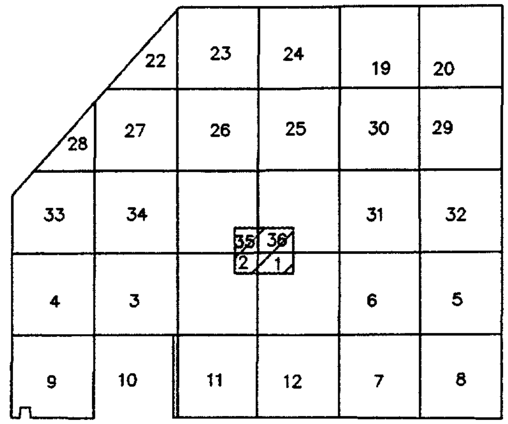
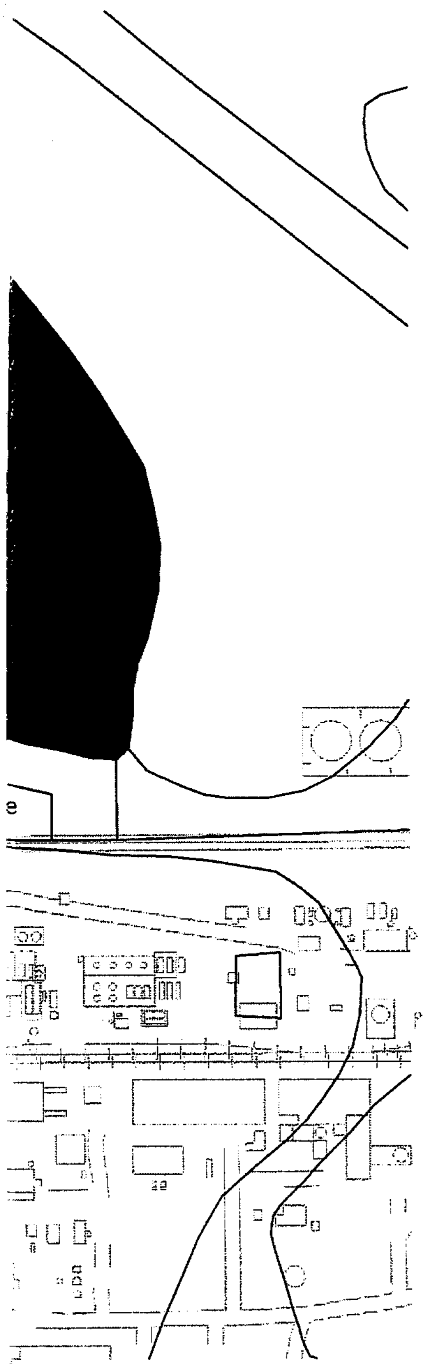


ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Section 36 Lime Basins Subgroup
SITE:NCSA-1b Lime Settling Basins Area

Buried M-1 Pits Subgroup
SITE:SPSA-1e, Buried M-1 Pits

Site Boundary

Buildings and Roads

36 Section Number

150 0 150 300 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 16.0-1

Site Locations
Lime Basins Medium Group

Rocky Mountain Arsenal.
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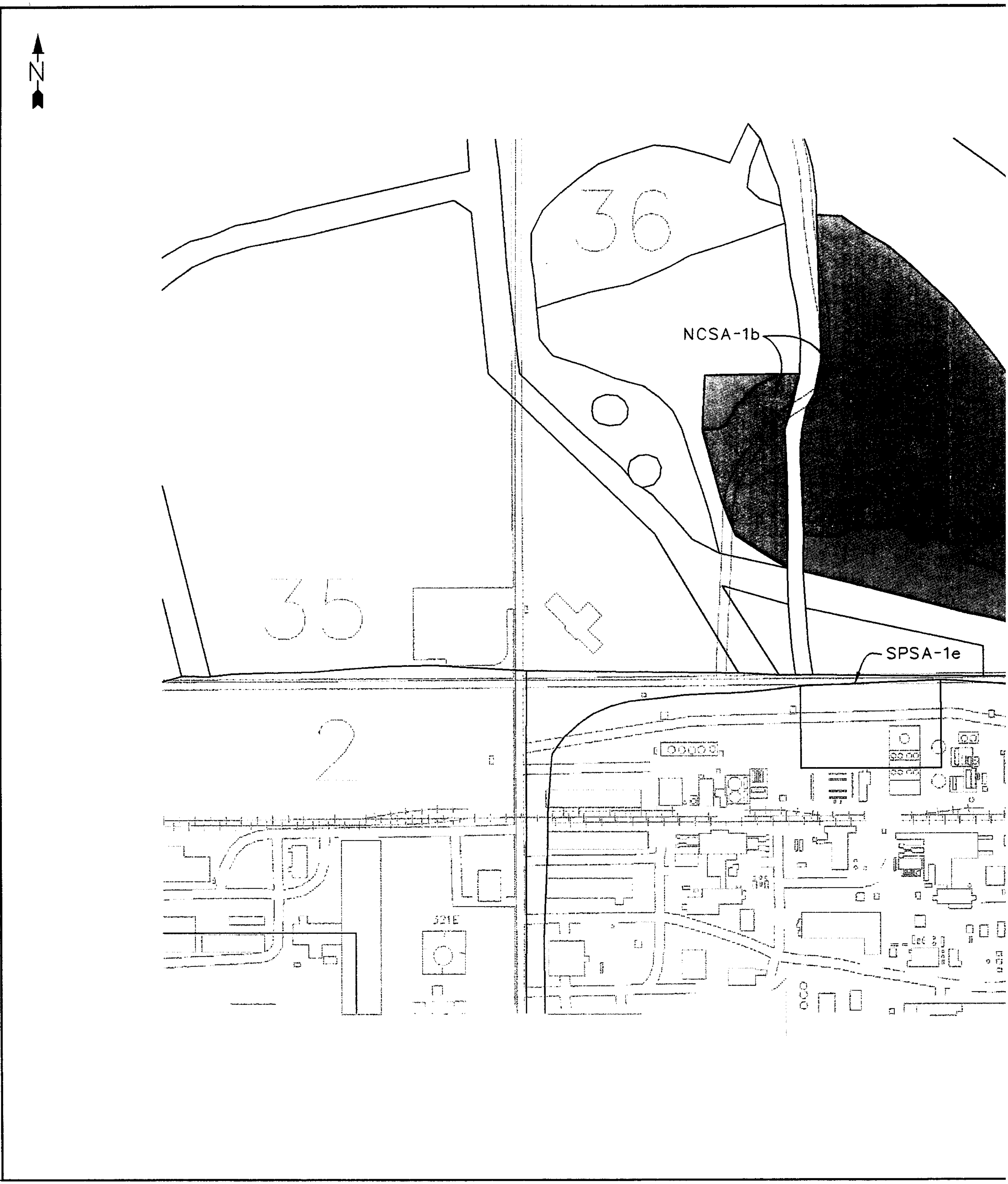
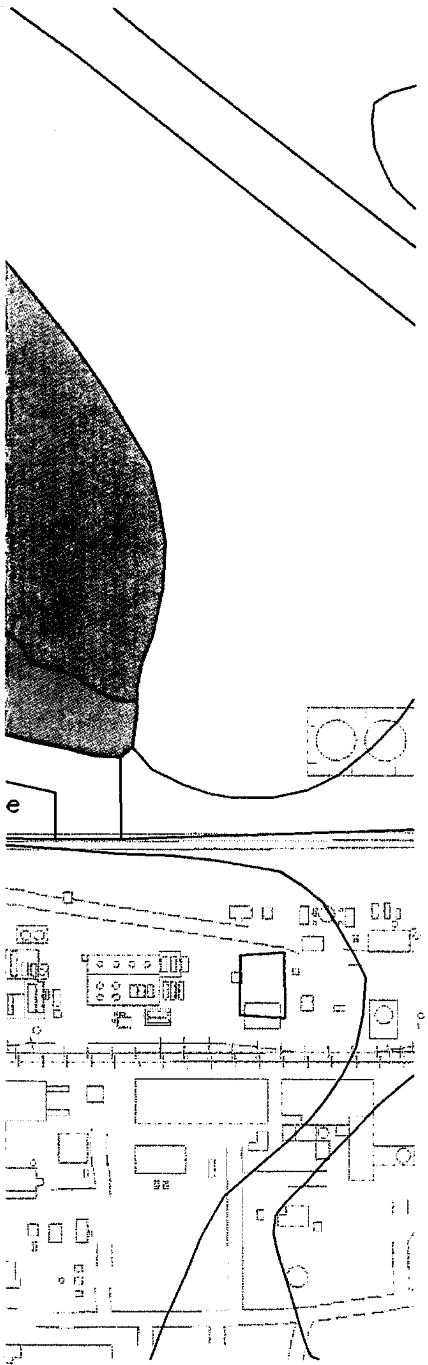
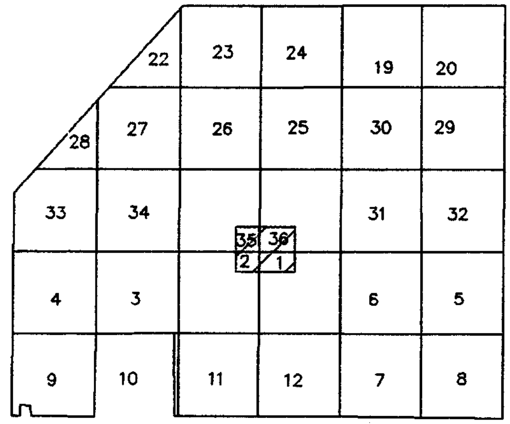




ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Biota Exceedance Area

Human Health Exceedance Area

Site Boundary

Buildings and Roads

36 Section Number

150 0 150 300 FEET

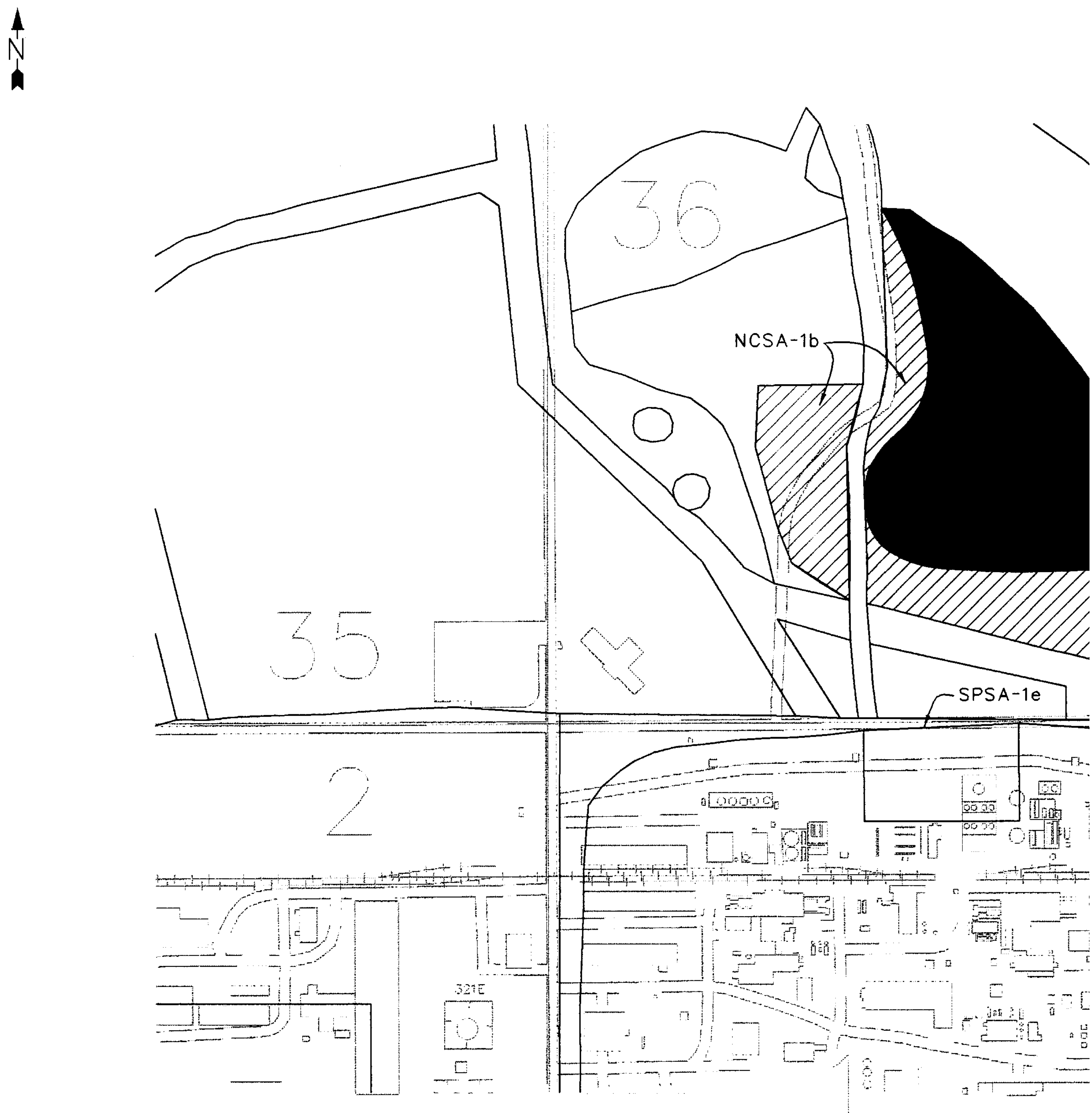
Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 16.1-1

Exceedance Areas
Section 36 Lime Basins Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated



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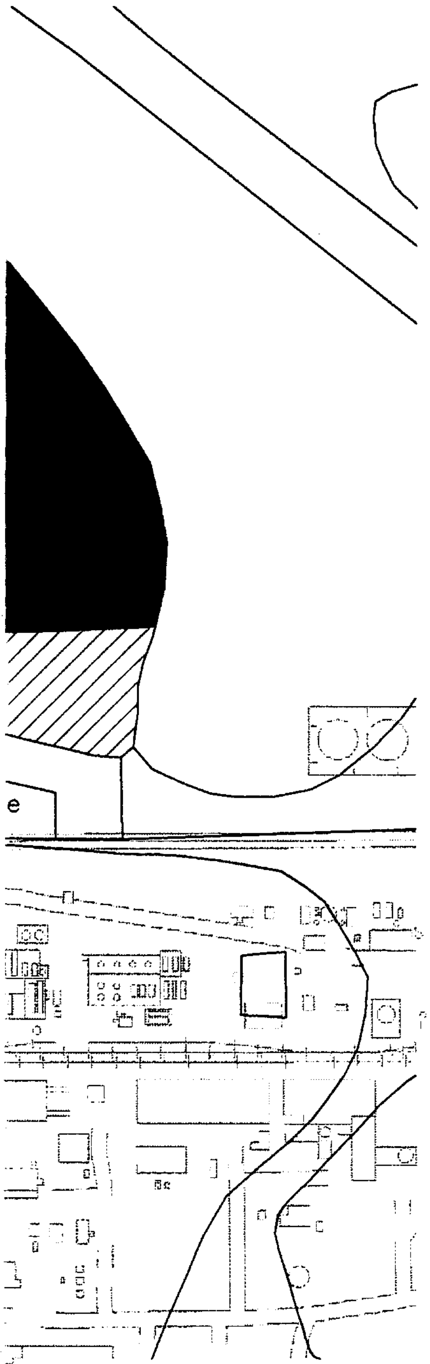
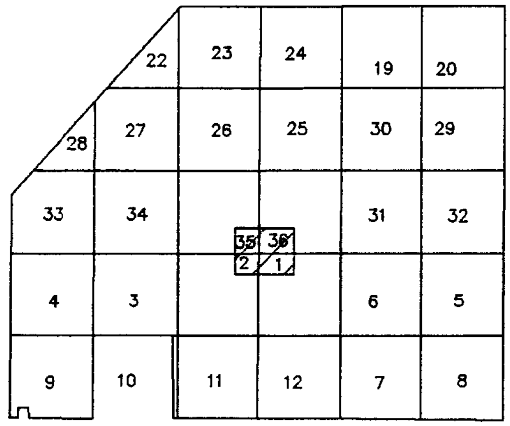


ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

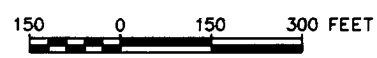
Human Health/Biota Exceedance Area

Potential Agent Presence Area

Site Boundary

Buildings and Roads

36 Section Number



Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 16.1-2

Potential Agent Presence Area
Section 36 Lime Basins Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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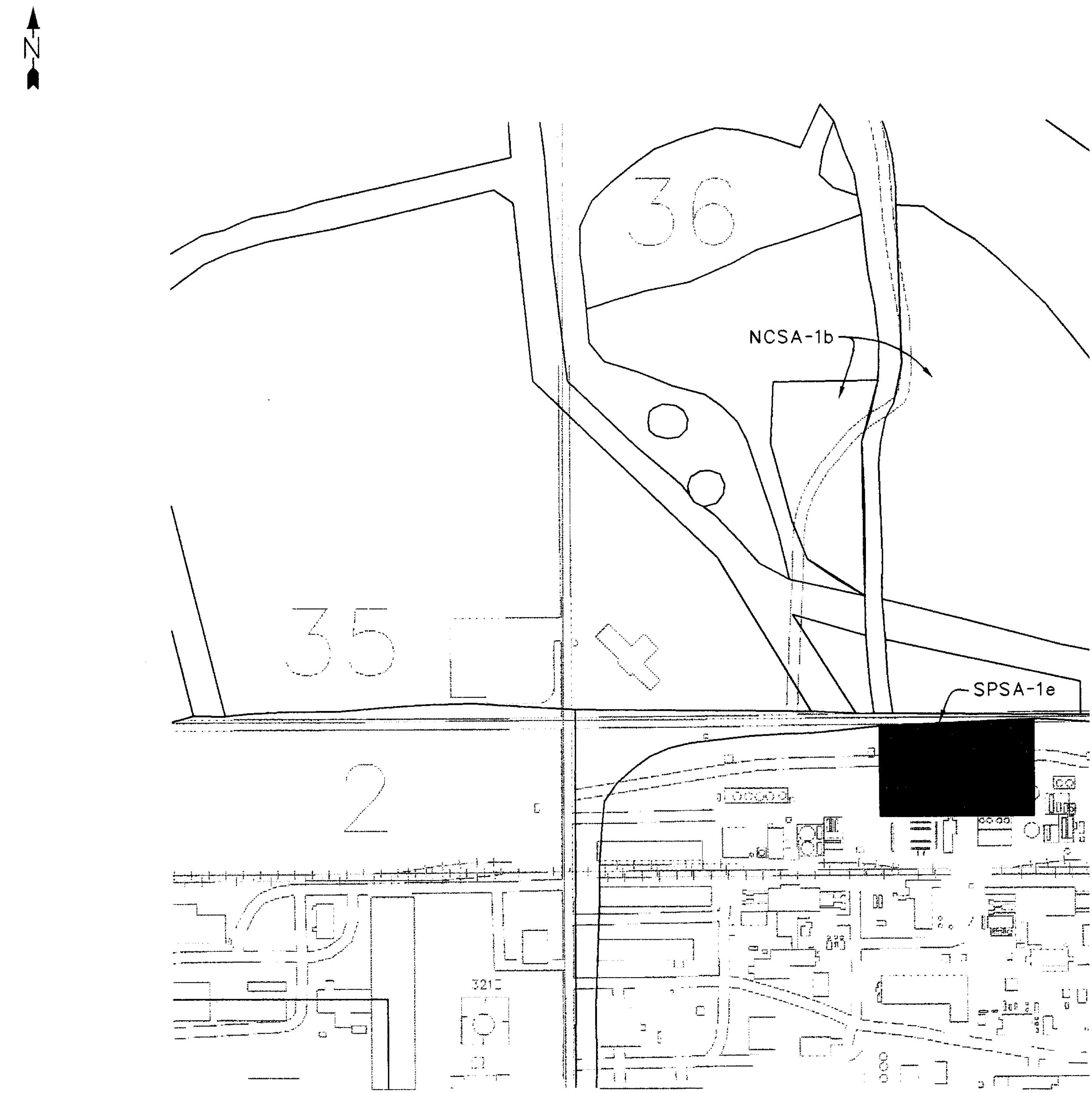
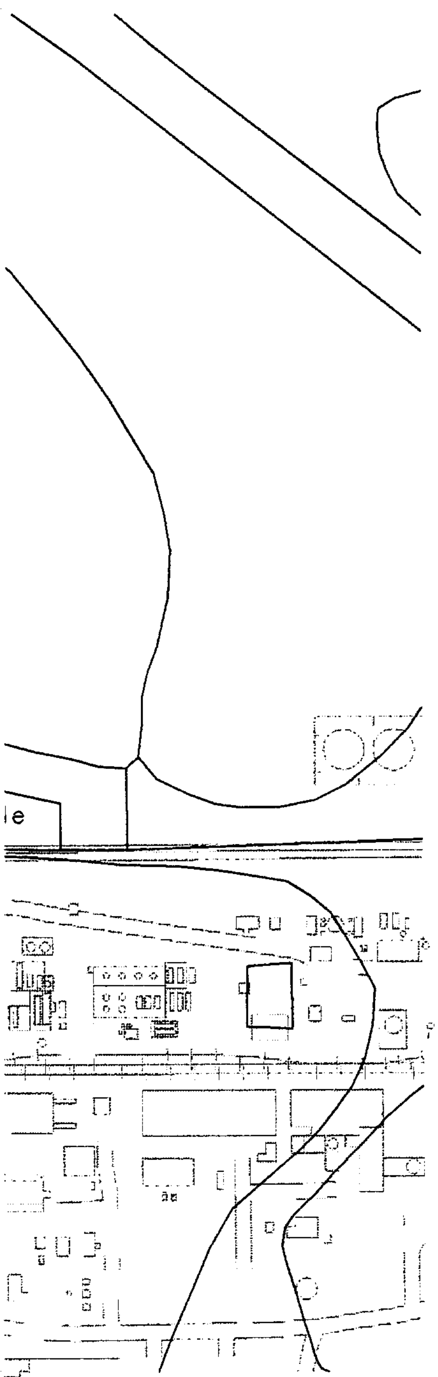
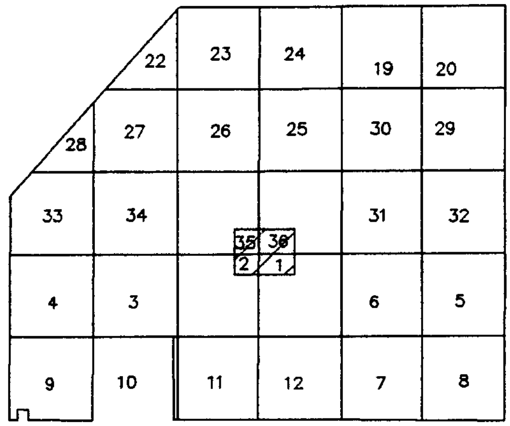




ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Principal Threat Exceedance Area

Site Boundary

Buildings and Roads

36 Section Number

150 0 150 300 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 16.4-1

Exceedance Areas
Buried M-1 Pits Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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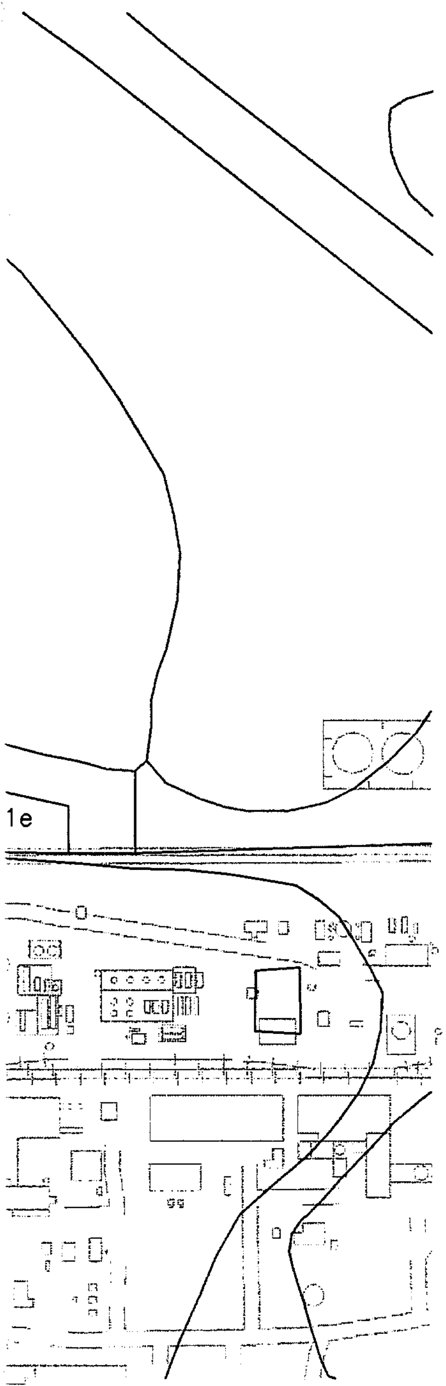
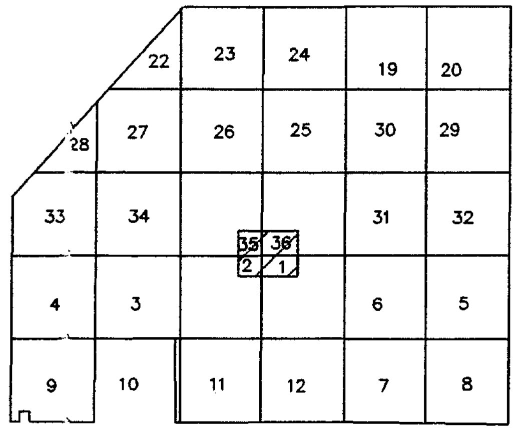


ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Human Health/Biota Exceedance Area

Potential Agent Presence Area

Site Boundary

Buildings and Roads

36 Section Number

150 0 150 300 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 16.4-2

Potential Agent Presence Area
Buried M-1 Pits Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

17.0 DETAILED ANALYSIS OF ALTERNATIVES FOR THE SOUTH PLANTS MEDIUM GROUP

The South Plants Medium Group is composed of 27 sites located within the South Plants Study Area. Processing areas, drainage ditches, tank farms, and storage area site types are included in this medium group. Contamination in the South Plants manufacturing complex is a result of agent demilitarization and chemical disposal, storage, or manufacturing processes. Soils from subgroups located in the north-central portion of South Plants potentially contain agent, and a small portion of the soils—those in the South Plants Balance of Areas Subgroup—potentially contain UXO. These sites are grouped together by type and contamination pattern to form four subgroups: South Plants Central Processing Area, South Plants Ditches, South Plants Tank Farm, and South Plants Balance of Area. Figure 17.0-1 shows the locations of the subgroups and their related sites.

The primary Human Health and Biota COCs in this medium group are OCPs, VOCs, and ICP metals, although CLC2A, arsenic, and mercury are also present at concentrations above the Human Health SEC. Sites within this medium group are identified as being principal threat areas and also as being potential sources of groundwater contamination. Portions of the South Plants Medium Group contain mercury above Biota SEC, but not above Human Health SEC. Table 17.0-1 presents the characteristics of the subgroups, including exceedance volumes and areas and COCs, and Appendix A presents volume and exceedance area calculations.

In the DSA, alternatives were developed and screened based on the general characteristics of the medium group. However, the retained alternatives do not necessarily apply to each subgroup. The characteristics of the four subgroups—including contaminants and concentrations, site configuration, and depth of contamination—were evaluated in the DAA to determine the subset of applicable alternatives from the range of alternatives retained in the DSA for the medium group. An alternative involving the installation of a clay/soil cap was considered for all four subgroups to evaluate the effectiveness of demolishing structures and containing the structural debris in place along with the soils. The area required for the clay/soil cap for the South Plants

Balance of Areas subgroup is larger than the exceedance area to allow for the demolition of structures and in-place containment of the exceedance soils and debris.

The following sections present the characteristics of each subgroup, an evaluation of the retained alternatives for the subgroup against the DAA criteria listed in the NCP (EPA 1990), and the selection of a preferred alternative based on a comparative analysis of the alternatives. The preferred alternatives are as follows:

- South Plants Central Processing Area Subgroup: Alternative 6a—Excavation of principal threat areas and treatment of organics by direct thermal desorption and of inorganics by solidification/stabilization followed by the installation of a clay/soil cap over the exceedance areas. The clay/soil cap contains soils from the Central Processing Area plus consolidated soils and structural debris from other portions of South Plants as grading fill.

- South Plants Ditches Subgroup: Alternative 6b—Excavation of principal threat areas and treatment by direct thermal desorption. Consolidation of remaining soils from ditches and containment within Central Processing Area.

- South Plants Tank Farm Subgroup: Alternative 16a—In situ treatment of VOCs by vacuum extraction and, for shallow soils above Biota SEC, by landfarm/agricultural practice.

- South Plants Balance of Area Subgroup: Alternative 6b—Excavation of principal threat areas and treatment by direct thermal desorption following agent screening and UXO clearance. Consolidation of remaining soils and containment within Central Processing Area.

17.1 SOUTH PLANTS CENTRAL PROCESSING AREA SUBGROUP CHARACTERISTICS

The South Plants Central Processing Area Subgroup is composed of site SPSA-1a (Central Processing Area) (Figure 17.0-1). This site contains soils that are contaminated by manufacturing or processing activities in South Plants. The 320,000 BCY of contaminated soils within this subgroup are considered principal threats based on analytical results and historical information. Most of the area of this site is considered a principal threat area (Figure 17.1-1), although human health and biota exceedances are generally located beneath the principal threat volume. There are 87,000 SY of soils that potentially contain agent in this subgroup. (Figure 17.2-2).

Table 17.1-1 provides a summary of contaminants, concentrations, and corresponding exceedance volumes for the South Plants Central Processing Area Subgroup and Table 17.1-2 summarizes the frequency of detections. OCPs, VOCs, CLC2A, DBCP, HCCPD, arsenic, mercury, and ICP metals are present in 440,000 BCY at maximum concentrations typically one to two orders of magnitude above the Human Health SEC. These COCs are detected at depths ranging from 0 to 10 ft below ground surface, although the majority are detected 0 to 6 ft below ground surface. For arsenic, DBCP, and some OCPs, the maximum concentrations also exceed the principal threat criteria. However, for all COCs, the average concentration does not exceed the principal threat criteria. There are 180,000 BCY of soils within this subgroup that contain OCPs, arsenic, and mercury at concentrations above the Biota SEC.

The area within the South Plants Central Processing Area Subgroup is poor-quality habitat although some mammals and birds use the structures in the area for shelter. Although burrowing animals are excluded from areas involving containment with a cap/cover, areas disturbed during remediation are revegetated with native grasses, thereby improving habitat value through remedial actions.

Site SPSA has been identified as the source of several groundwater contamination plumes that occur in the unconfined aquifer and migrate away from the site. Groundwater alternatives that address the installation of individual plume group remediation systems are being evaluated. Coordination of alternatives developed for the soils medium with those developed for the water medium is limited to excavation or capping. Due to the contaminant mass already in the aquifer, it is unlikely that the remediation of this subgroup would impact the groundwater quality in the near-term, but it would prevent additional contaminant loading of the groundwater. Some of the contaminated soils in the South Plants Central Processing Area Subgroup may be located beneath structures (Figure 17.1-1), most of which belong to the No Future Use, Manufacturing History–Process History Subgroup and No Future Use, Agent History Medium Group in the structures medium. The treatment or landfilling of contaminated soils beneath these structures first requires the demolition of the structures and removal of structural debris. The capping of

soils within the South Plants Central Processing Area Subgroup also requires the demolition of structures, but the structural debris from the No Future Use, Manufacturing History–Process History Subgroup can be contained beneath the cap.

17.2 SOUTH PLANTS CENTRAL PROCESSING AREA SUBGROUP EVALUATION OF ALTERNATIVES

The six alternatives for the South Plants Central Processing Area Subgroup vary in approach from no action to treatment. The retained alternatives from the DSA were modified as follows to account for the treatment of principal threat volumes: the containment alternative (Alternative 6) was modified to exclude slurry walls based on the evaluation of groundwater removal and dewatering alternatives in addition this alternative addresses the containment of the South Plants Medium Group as a whole; the vacuum extraction alternative (Alternative 16) was not evaluated for this subgroup since VOCs, which are the focus of this alternative, are not present in a significant portion of the exceedance volume; and the in situ treatment alternative (Alternative 20), which consists of multiple direct treatment technologies addressing predominantly surficial contamination, was not evaluated since most of the contamination is located 0 to 6 ft below ground surface. The following subsections present a description of each retained alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedances (which is listed first), an alternative to address areas of biota exceedances (the "B" alternative), and an alternative to address potential agent presence (the "A" alternative).

17.2.1 Alternative 1/Ba/A1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternatives B1: No Additional Action (Provisions of FFA) and A1: No Additional Action (Provisions of FFA), applies to all 220,000 SY of exceedance area in the South Plants Central Processing Area Subgroup. The 620,000 BCY of human health, biota, and potential agent exceedance volumes remain in place. No action is taken to reduce potential human health or biota exposure to COCs,

prevent the acute chemical hazards from agent, or reduce migration of contaminants to groundwater from sites in this subgroup; however, this alternative complies with the provisions of the FFA. Exceedance areas are monitored (an average of 27 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 17.2-1 presents an evaluation of the alternative against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved under this alternative because soils are not treated and remain in place without controls being implemented. The residual risk is high due to the high levels of contamination remaining at the site and the migration of contamination to groundwater is not reduced. Natural attenuation of untreated soils is ongoing, but the estimated time frame for achieving PRGs is more than 30 years. The poor-quality habitat at the sites is not changed. This alternative does not impact the structures located on site and consequently does not preclude the selection of any alternatives for the structures medium. The total estimated present worth cost of this alternative is $1,800,000. Table B4.14-1 details the costing for this alternative.

17.2.2 Alternative 1b/B1/A1: Direct Thermal Desorption and Direct Solidification/Stabilization of Principal Threat Volume; No Additional Action

Alternative 1b: Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA) and Alternative A1: No Additional Action (Provisions of FFA), involves the treatment of 320,000 BCY of principal threat exceedances in the South Plants Central Processing Area Subgroup. Prior to excavation, the principal threat soil is screened for the presence of agent with real-time monitoring equipment. If agent presence is identified and confirmed by RMA laboratory analysis, the soil excavated and treated by rotary kiln incineration (Alternative A4).

Alternatives developed for structures located in this subgroup must be coordinated with this alternative as structures within the principal threat areas require demolition and subsequent removal of debris. Existing buried utilities are removed during excavation and consolidated with the structural debris. Due to the potential for odor problems, excavation is conducted so that minimal area is uncovered and exposed at any one time, and daily soil cover or plastic liners are installed over excavated areas to further minimize odor emissions. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed.

The principal threat volume of 320,000 BCY is excavated and transported to the centralized treatment facility for thermal desorption and solidification. (Section 4.6 discusses details of these technologies.) The principal threat soil is considered to be saturated (i.e., moisture content of 20 percent) due to the high water table in South Plants. Based on this moisture content, the thermal desorber processes the soils at a rate of approximately 1,300 BCY/day at a discharge temperature of 300°C, assuming a total soils residence time of 50 minutes. (Section 4.6.24 discusses emission controls for off gases from thermal desorption.) The 3,200 BCY of particulates from the scrubber blowdown equipment, approximately 1 percent of the solids feed, are disposed in the on-post hazardous waste landfill due to high inorganic concentrations and salts. Construction of the thermal desorber facility takes 1 year, and an additional year is required for testing.

The 4,000 BCY of principal threat soil with high levels of inorganic contamination are treated in the adjacent cement-based solidification facility (Section 4.6.22). The inorganic contaminants in these soils are immobilized by mixing cement with the soil at a ratio of 20 percent. The solidified soils expand to a volume of 4,800 BCY after solidification due to the addition of the binding materials and bulking from excavation.

Treated soils from both treatment processes are returned as backfill to the sites. A minimum of 4 ft of treated soils from thermal desorption are recontoured over the solidified soil to ensure the integrity of the solidified materials and to prevent freeze/thaw degradation of the materials. Since

thermal desorption removes much of the organic content in the soil, the disturbed area is covered with 6 inches of topsoil and revegetated with native grasses to improve the habitat quality of the site. Long-term monitoring of the solidified materials and maintenance of the soil cover is required.

The 120,000 BCY of untreated soil in the South Plants Central Processing Area Subgroup that are not principal threats fall under the no additional action portion of the alternative. No action is taken for these areas to reduce potential human or biota exposure to COCs, prevent acute chemical hazards from agent, or reduce groundwater contamination from sites in this subgroup. Based on the average concentration of COCs, the Human Health SECs are achieved by treatment of the principal threat area, and a low residual risk is present only for biota. Exceedance areas are monitored (an average of 27 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 17.2-2 presents an evaluation of Alternative 1b against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved under this alternative as contaminated soils remain in place without controls being initiated. Natural attenuation of untreated soils is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The highest levels of contamination in principal threat areas are treated, so the residual risk is low. The migration of contaminants to groundwater is significantly reduced through the removal of the principal threat areas, but long-term protection of groundwater is uncertain. This alternative complies with the provisions of the FFA. The time frame for completion of the alternative is 3 years, including the 2 years required for construction and testing of the centralized thermal desorption facility. The overall poor-quality habitat at the site is not changed, except for principal threat areas, where it is improved through revegetation with native grasses. The total estimated present worth cost of this alternative is $57,000,000. Table B4.14-1b details the costing for this alternative.

17.2.3 Alternative 3/B3/A4: Landfill

For the South Plants Central Processing Area Subgroup, Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill) and Alternative A4: Incineration/Pyrolysis (Rotary Kiln), consists of landfilling 620,000 BCY of contaminated soils. Prior to excavation, all of the structures, including foundations, within the Central Processing Area must be demolished and removed, which limits the alternatives currently being evaluated for structures in this area. Utilities under the Central Processing Area are also excavated and consolidated with the structural debris. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevation after the man-made influences (i.e., leaking sewers) are removed. During excavation, minimal area is exposed at any one time to reduce potential odor problems, and daily soil cover or plastic liners are placed over each excavation to further control odor emissions.

The South Plants Central Processing Area Subgroup contains 87,000 SY of soils with potential agent presence. This soil volume is screened for agent prior to excavation using real-time field analytical methods. Any agent identified and confirmed by RMA laboratory analysis is treated by rotary kiln incineration. (Section 4.6 discusses details of incineration.) It is estimated that there are approximately 290 BCY of agent-contaminated soils in this subgroup. Operating parameters of the incinerator include an operating temperature of 760°C, residence time of 66 minutes, and processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the soils feed (3 BCY) is recovered in the scrubber blowdown, and placed in the on-post hazardous waste landfill due to high inorganic concentrations and salts. The treated soils are then returned to the site as backfill.

For the balance of the site, 620,000 BCY of contaminated soils are excavated and placed in a centralized, multiple cell on-post landfill. Construction of the first cell and associated facilities takes 1 year. (Section 4.6 discusses construction of the landfill in detail.) The site excavations are backfilled with borrow soils from the on-post borrow area, returning the site to original grade. Topsoil is placed over the backfilled area and revegetated with native grasses, thus improving

the habitat quality at the site. The borrow area is recontoured and revegetated to restore habitat. After disposal is complete, the landfill cover is installed and revegetated, although access restrictions (fencing and biota barriers) eliminate the habitat value of the landfill. The landfill requires long-term maintenance of the cover, leachate collection and treatment, and monitoring of potential leachate migration.

Table 17.2-3 evaluates Alternative 3 against the EPA criteria for the DAA. This alternative achieves RAOs, and promotes the long-term protection of groundwater, since the contaminated soils are excavated and transferred to a containment cell or incinerated. Although habitat is eliminated at the landfill, it is improved at the site and restored at the borrow area. The disposal of 620,000 BCY of human health and biota exceedance volume takes approximately 3 years, based on a 1-year construction time frame for the landfill cell and a 2-year construction period for the incinerator. The total estimated present worth cost of this alternative is $36,000,000. Table B4.14-3 details the costing for this alternative.

17.2.4 Alternative 6/B5/A2: Caps/Covers

Alternative 6: Caps/Covers (Clay/Soil Cap), combined with Alternative B5: Caps/Covers (Clay/Soil Cap) and Alternative A2: Caps/Covers (Clay/Soil Cap), addresses the containment of the entire South Plants Medium Group (1,700,000 SY), which includes the 220,000 SY of human health and biota exceedance areas as well as the potential agent presence area (See Figure 17.2-1). Before any cover materials are installed, existing structures are demolished and either contained in-place or consolidated, the subgrade is compacted, and the surface is crowned with 500,000 BCY of borrow material as grading fill to control surface-water runoff. The human health and biota exceedance areas are covered by a 2-ft layer of low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. The capped area is then revegetated to restore the habitat. The fill materials for the cap are excavated from the on-post borrow area, and topsoil is obtained off post. The capping operations take 1 year to complete. Maintenance activities (mowing and replacing eroded soils) ensure the continued integrity of the soil cap.

Table 17.2-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through containment. The potential for migration of contaminants to groundwater is greatly reduced, although mobility reductions may be reversible if the cap degrades or leaks. Habitat is improved at the site after remediation, but remains restricted to burrowing animals. Long-term maintenance is required to ensure the integrity of the cap. The estimated present worth cost of the alternative is $22,000,000. Table B4.14-6 details the costing for this alternative.

17.2.5 Alternative 6a/B5/A2: Direct Thermal Desorption and Direct Solidification/Stabilization of Principal Threat Volume; Caps/Covers

Alternative 6a: Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) along with Alternative B5: Caps/Covers (Clay/Soil Cap) and Alternative A2: Caps/Covers (Clay/Soil Cap), addresses the containment of 220,000 SY of soils with human health, biota, and potential agent exceedances. The principal threat area is screened for the presence of agent prior to excavation. If any agent is identified in soils during the screening and then confirmed by RMA laboratory analysis, they are excavated and treated by rotary kiln incineration (Alternative A4). Due to the potential for odor problems, excavation is conducted so that minimal area is uncovered and exposed at any one time, and daily soil cover or plastic liners are installed over excavated areas to further eliminate odor emissions. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed.

The demolition and removal of structures within the Central Processing Area is required to allow the excavation of contaminated soils. However, the structural debris from the No Future Use, Manufacturing History–Process History Subgroup can be contained beneath the cap as grading fill. Abandoned utilities encountered during excavation are removed and consolidated with the structural debris. The structures alternatives developed for this area consider the backfill of the foundation excavations with borrow material; however, timing the backfilling of the excavations

and the backfill materials used is dependent upon which soils alternative is selected for the South Plants Central Processing Area Subgroup.

The 320,000 BCY of principal threat organic exceedances is excavated and transported to the centralized facility for thermal desorption and solidification. (Section 4.6 discusses these technologies in detail.) The soil for this subgroup is saturated (moisture content of 20 percent). Based on this moisture content, the thermal desorber processes the soil at a rate of approximately 1,300 BCY/day. The soils are discharged at a temperature of 300°C, assuming a total soils residence time of 50 minutes. The thermal desorber takes 1 year to construct, and requires an additional year for testing. (Section 4.6.24 discusses off gas treatment in detail). Approximately 1 percent of the total soils feed (3,200 BCY) from scrubber blowdown is disposed in the on-post hazardous waste landfill.

The 4,000 BCY of principal threat soil with high levels of inorganic contaminants are treated in the adjacent cement-based solidification facility (Section 4.6.22). The inorganic contaminants in these soils are immobilized by mixing cement with the soil at a ratio of 20 percent. Due to bulking during excavation and swelling during solidification, the volume of solidified soils is increased by 20 percent, resulting in a total solidified mass of 4,800 BCY. Treated soil from both processes is returned and backfilled into the sites. A minimum of 4 ft of thermally desorbed soil is recontoured over the solidified mass to prevent freeze/thaw degradation and preserve the integrity of the solidified mass.

Following treatment of the principal threat volume, a clay/soil cap is installed over the entire human health and biota exceedance area, which includes the potential agent areas. Prior to capping, the subsurface is compacted and regraded to minimize variations in the subgrade. The cap consists of a 2-ft layer of compacted low-permeability soil, a 1-ft biota barrier, and 4-ft of soil/vegetation layer that includes 6 inches of topsoil. Although site remediation is completed by revegetation of the cover with native grasses to improve the habitat quality of the site, restrictions to burrowing animals through biota controls ensure the integrity of the cover and

prevent exposure. The containment of the Central Processing Area requires placing between 500,000 to 1,000,000 BCY of soils as grading fill (depending on the final grade required) to bring the area to be capped to the design grade of 1.5 to 3 percent as described in the Technology Description Volume.

Figure 17.2-2 presents a schematic representation of this alternative including the demolition and removal of structures and foundations, installation of grading fill to backfill the excavations, and installation of a clay/soil cap. Instead of using borrow material for the grading fill, contaminated soils from other portions of South Plants are consolidated within the Central Processing Area prior to capping. The levels of contamination in the consolidated soils are lower than the contaminated soils remaining in the Central Processing Area. If the consolidation alternatives are not selected for the other areas in South Plants, then borrow materials are used as grading fill.

Table 17.2-5 evaluates Alternative 6a against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through treatment of organic and inorganic principal threat volumes and containment of remaining exceedance soils. The migration of contaminants to groundwater is greatly reduced and exposure pathways are interrupted. Biota disturbance is minimal due to existing poor-quality habitat, which is improved through revegetation. The thermal desorption of 320,000 BCY takes approximately 3 years including 2 years for construction and testing of the thermal desorber. Long-term monitoring includes maintenance of the clay/soil cap and of the landfill containing the thermal desorber particulates. The total estimated present worth cost of this alternative is $69,000,000. Table B4.14-6a details the costing for this alternative.

17.2.6 <u>Alternative 13/B6/A4: Direct Thermal Desorption; Direct Solidification/Stabilization</u>
Alternative 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification), paired with Alternative B6: Direct Thermal Desorption (Direct Heating) and Alternative A4: Incineration/Pyrolysis (Rotary Kiln), treats 580,000 BCY of soils

with human health organic and biota exceedances by thermal desorption and 58,000 BCY of soils with inorganic exceedances by solidification. (Section 4.6 discusses the details of these technologies.) Before treatment of contaminated soils for the South Plants Central Processing Area Subgroup, demolition and removal of a number of structures are required, which limits alternatives currently being evaluated for structures in this area. Existing utilities are removed during excavation and consolidated with the structural debris. Due to the potential for odor problems, excavation is conducted so that minimal area is exposed at any one time, and a daily soil cover or plastic liners are installed over excavated areas to further eliminate odor emissions. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevation after man-made influences (i.e., leaking sewers) are removed.

Prior to excavation, 87,000 SY are screened for agent with real-time monitoring equipment. Soil confirmed to contain agent by RMA laboratory analysis (an estimated 290 BCY) is treated by rotary kiln incinerator (Alternative A4). (Section 4.6 discusses the details of incineration.) Operating parameters of the rotary kiln incinerator include an operating temperature of 760°C, a total residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the soils feed (3 BCY) is recovered from scrubber blowdown and is placed in an on-post hazardous waste landfill. The treated soils are returned to the site as backfill.

The 580,000 BCY of organic exceedance volume, after being screened for agent, are transported to the thermal desorber for treatment. The soils for this subgroup are classified as saturated (i.e., soil moisture content of 20 percent). Based on this moisture content, the thermal desorber has a processing rate of 1,300 BCY/hr, a discharge temperature of 300°C, and a total soils residence time of 50 minutes. The thermal desorber takes 1 year to build, and requires an additional year for testing prior to operation. The treated organic soils are returned to the site excavations since no further treatment is required for the low levels of arsenic and mercury that are volatilized during thermal desorption. (Section 4.6.24 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the soils feed (5,800 BCY) is recovered as particulates

from the scrubber blowdown equipment and is placed in the on-post hazardous waste landfill. The treated soils are returned to the excavation as backfill and to cover the solidified soils. Soils with remaining inorganic exceedances are transported to the solidification facility for further treatment.

The 58,000 BCY of soils with inorganic exceedances are solidified using a portable pug mill capable of treating 46 BCY/day (Section 4.6.22). The contaminated soils are treated by adding cement as a binder at a 20 percent weight ratio in order to immobilize inorganics exceedances in the soils. During excavation and solidification, the total volume of contaminated soils increases by 20 percent, which results in a total volume of 70,000 BCY. The solidified soils are backfilled in the site excavations. These soils are then covered with a minimum of 4 ft of thermally treated soils to ensure the integrity of the solidified materials and prevent freeze/thaw degradation. Since thermal desorption destroys the natural organic content of the treated soil, topsoil, obtained off post, is placed on top of the treated area (220,000 SY) and revegetated with native grasses to improve habitat quality. Long-term maintenance of the cover and monitoring of the solidified soils are required.

Table 17.2-6 evaluates Alternative 13 against the EPA criteria for the DAA. This alternative achieves RAOs since all contaminated soils are treated to stabilize or destroy the contaminants. The impacts on groundwater quality are reduced through the treatment of contaminated soils and the habitat is improved at the site following revegetation. Thermal desorption of 580,000 BCY and solidification of 58,000 BCY takes approximately 7 years, including the 2 years required for construction and testing of the thermal desorption and incineration facilities. The total estimated present worth cost of this alternative is $100,000,000. Table B4.14-13 details the costing for this alternative.

17.2.7 Alternative 19/B11a/A4: In Situ Thermal Treatment; In Situ Solidification/Stabilization

Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification), along with Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating) and Alternative A4: Incineration/Pyrolysis (Rotary Kiln), treats 580,000 BCY of human health organic and biota exceedance soils. Dewatering is not anticipated to be required based on the projected reduction in groundwater elevation after man-made influences (i.e., leaking sewers) are removed. Existing structures in the Central Processing Area must be demolished and consolidated for this alternative, which limits alternatives currently being evaluated for structures in this area. Utilities are removed and consolidated with the structural debris.

Before in situ treatment, 87,000 SY of soils with potential agent presence are screened using real-time field analytical methods. If agent is not present in the soils, they are treated by RF heating. If agent is identified and confirmed by RMA laboratory analysis, the agent-contaminated soils are excavated and treated on-post by rotary kiln incineration. (Section 4.6 discusses the details of rotary kiln incineration.) It is estimated that there are approximately 290 BCY of agent-contaminated soils in this subgroup. Operating parameters of the rotary kiln incinerator include an operating temperature of 760°C, a total residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for the off gas from incineration.) Approximately 1 percent of the soils feed (3 BCY) is recovered as particulates from the scrubber blowdown and is placed in an on-post hazardous waste landfill. The treated soils are then returned to the site as backfill.

After agent screening, 580,000 BCY of human health organic and biota exceedance soils are treated by in situ RF heating. RF heating volatilizes the organic contaminants by raising the temperature of the soils to more than 250°C. The volatilized contaminants are then collected and treated in the off-gas treatment system (Section 4.6.29). One RF unit is used for the South Plants Central Processing Area Subgroup. Soils in this subgroup were assumed to have a moisture content of 20 percent and to be contaminated from 0 to 10 ft below ground surface. Based on

these assumptions, the unit treats a 100-ft-long, 48-ft-wide, 10-ft-deep block of soils at a treatment rate of approximately 130 BCY/day. The liquid sidestream, which contains predominantly salts, is transported to the thermal desorption facility for treatment along with the effluent from the scrubber. RF heating only treats the organic contaminants; therefore, soils containing inorganic contaminants require treatment by in situ cement-based solidification.

The human health inorganic soil volume of 58,000 BCY is solidified using a transportable track-mounted boring/mixing unit and a cement batch plant capable of processing 600 BCY/day. Portland cement is mixed with excavated soil at a ratio of 20 percent by weight. The soil, upon solidification, swells approximately 20 percent due to the incorporation of the cement. A soil cover consisting of 4 ft of borrow material from the on-post borrow area is placed over the solidified soil (44,000 SY) to ensure the integrity of the solidified materials and minimize freeze/thaw degradation. Following treatment, a 6-inch layer of topsoil obtained off post is placed over the combined human health and biota exceedance area of 220,000 SY and is revegetated with native grasses to improve the habitat quality of the site. The borrow area is recontoured and revegetated. Long-term maintenance of the cover and monitoring of the solidified soils are required.

Table 17.2-7 evaluates the alternative against the EPA criteria for the DAA. RF heating theoretically achieves Human Health and Biota RAOs with low residual risk since all OCPs and most volatile metals are driven from the soil by this form of in situ thermal treatment. However, based on the 97 to 99 percent DRE achieved during the RMA pilot-scale test, the RF heating technology failed to confirm the temperature distribution and OCP removal required for confident treatment of soils to achieve PRGs. Based on this technology's DRE of 97 to 99.9 percent, contaminants in this medium group are generally reduced to meet Human Health PRGs. The residual levels of OCP contamination are anticipated to be within the acceptable risk range for human health (10^{-6} to 10^{-4} excess cancer risk), but the residual OCP levels are anticipated to be greater than the Biota PRGs. The treated areas are revegetated to improve habitat, but some biota risk remains due to the failure to achieve PRGs. The implementability of in situ RF heating

is questionable since there is no commercial source for the equipment and the technique is as yet unproven at full scale. RF treatment of 580,000 BCY of contaminated soils is feasible in 14 years. The migration of contaminants to groundwater is reduced through treatment. The total estimated present worth cost of this alternative is $260,000,000. Table B4.14-19 details the costing for this alternative.

17.3 SOUTH PLANTS CENTRAL PROCESSING AREA SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The South Plants Central Processing Area Subgroup has 620,000 BCY of exceedance volume containing primarily OCPs, arsenic and mercury, along with organics and ICP metals. This contamination is a result of manufacturing and processing activities conducted in South Plants. Approximately 3 percent of OCP samples exceed the Human Health SEC (Table 17.1-2). An additional 9 percent of OCP samples and 12 percent of arsenic and mercury samples exceed the Biota SEC. The average concentrations of OCPs and DBCP within the human health exceedance volume are greater than the Human Health SEC, and average concentrations of exceedance contaminants within the biota exceedance volume are generally greater than the Biota SEC (Table 17.1-1). This subgroup, therefore, presents a significant potential risk to human health and biota.

Principal threat criteria are exceeded by maximum concentrations of arsenic, DBCP, and some OCPs. Based on these analyses and historical information, 320,000 BCY of the subgroup are designated as principal threats. Agent is potentially present in 87,000 SY of the subgroup based on site history, and the subgroup is also identified as the source of several groundwater contamination plumes.

The area within the subgroup has poor-quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration following remediation, so no significant habitat impacts are expected, although alternatives that involve containment with a cap/cover require the exclusion of burrowing animals. Before soils are excavated at this site, the soils are sampled to identify agent presence, an activity that requires health and safety

protection for site workers. In addition, to reduce odor emissions, minimal is exposed to the atmosphere at any one time, and a daily cover or plastic liner is used to prevent odor emissions from impacting the community.

In summary, this subgroup contains soils that exceed Human Health and Biota SEC, and an area of principal threat exceedances that encompasses much of the site. In selecting the preferred alternative for this subgroup, the short-term risks of worker exposure and community impacts form the potential release of vapors must be weighed against the longer-term risks of contaminant migration if contaminants are left in place.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs as untreated soils remain without controls being implemented and it is eliminated from further consideration as the preferred alternative. Alternative 1b: Direct Thermal Desorption and Direct Solidification/Stabilization of Principal Threat Volume; No Additional Action treats the highest levels of contamination, but does not achieve Human Health or Biota RAOs in the remaining volume and is therefore also eliminated from further consideration in the selection of the preferred alternative. The remaining five alternatives achieve RAOs, and meet the two DAA threshold criteria: protective of human health and the environment and compliance with action-specific and location-specific ARARs.

Alternative 19: In Situ Thermal Treatment; In Situ Solidification/Stabilization achieves RAOs through treatment, and generally reduces concentrations to achieve PRGs at 10^{-6} excess cancer risk, which is the point of departure for treatment. Residual concentrations are within the acceptable range for human health excess cancer risk, although Biota PRGs are not achieved. In addition, the technology for RF heating is not available and is unproven at full scale.

Alternative 13: Direct Thermal Desorption; Direct Solidification/Stabilization and Alternative 6a: Direct Thermal Desorption and Direct Solidification/Stabilization of Principal Threat Volume; Caps/Covers, both use direct thermal desorption and solidification to achieve RAOs to

varying degrees. Alternative 13 exhibits significantly higher cost ($100,000,000) than the partial treatment alternative ($69,000,000) as the entire exceedance area is treated rather than just the principal threat volume. Alternative 3: Landfill uses containment rather than treatment to reduce contaminant mobility, but also requires the excavation of the entire exceedance area. The cost of this alternative is $36,000,000. Alternative 6: Caps/Covers also achieves RAOs through containment but is dependent on the selection of Alternative 6: Caps/Covers for the remaining subgroups.

The preferred alternative for the South Plants Central Processing Area Subgroup is Alternative 6a: Direct Thermal Desorption and Direct Solidification/Stabilization of Principal Threat Volume; Caps/Covers. This alternative is cost effective since only the principal threat volume is treated and the balance of the exceedance areas are contained. This alternative also reduces the overall remediation costs at RMA as exceedance soils from other portions of South Plants can be consolidated in the Central Processing Area as grading fill prior to capping. Between 500,000 BCY and 1,000,000 BCY of soils are required as grading fill for this subgroup to achieve the design grades for capping. The alternative is consistent with NCP guidance on treatment for higher levels of contamination and the use of engineering controls (capping) for lower levels of contamination. The installation of the clay/soil cap and treatment of the principal threat volume significantly reduces the migration of contaminants to groundwater. The installation of the cap must be coordinated with the phases scheduled for the preferred groundwater alternative for the South Plants Plume Group as discussed in Section 9 of the Water DAA.

Using contaminated soils from other portions of South Plants reduces the number of containment locations at RMA, thereby reducing the areas requiring long-term maintenance. Monitoring and maintenance is established as part of this alternative for the South Plants Central Processing Area Subgroup, and the consolidation of materials within this area eliminates the need for additional monitoring and maintenance at other sites where contaminants could have been capped in place instead of consolidated. Although additional contaminant mass is placed in the Central

Processing Area from the consolidation of contaminated soils, the levels of contamination in consolidated soils are lower than those already present. The installation of a clay/soil cap contains this contamination and significantly reduces the risks for groundwater contamination in the area of the South Plants Central Processing Area Subgroup.

The demolition and removal of structures within the Central Processing Area is required to allow the excavation of contaminated soils. However, the structural debris from the No Future Use, Manufacturing History–Process History Subgroup can be contained beneath the cap as grading fill as described in Section 6 of the Structures DAA. Abandoned utilities encountered during excavation are removed and consolidated with the structural debris. The structures alternatives developed for this area consider the backfill of the foundation excavations with borrow material; however, timing the backfilling of the excavations and the backfill materials used is dependent upon which soils alternative is selected for the South Plants Central Processing Area Subgroup.

17.4 SOUTH PLANTS DITCHES SUBGROUP CHARACTERISTICS

The South Plants Ditches Subgroup is composed of sites SPSA-1d (Drainage Ditches), SPSA-2d (Drainage Ditches), SPSA-3a (Drainage Ditches), SPSA-4a (Drainage Ditches), SPSA-5a (Drainage Ditches), SPSA-8b (Drainage Ditches), and SPSA-9a (Drainage Ditches) (Figure 17.0-1. These sites contain soils that were contaminated by surface-water runoff from manufacturing or processing activities in South Plants. Agent-contaminated soils are not anticipated in this subgroup.

The South Plants Ditches Subgroup contains 60,000 BCY of soils contaminated with OCPs and ICP metals above the Human Health SEC at depths ranging from 0 to 10 ft below ground surface. Table 17.4-1 provides a summary of contaminants, concentrations, and corresponding exceedance values for this subgroup while Table 17.4-2 summaries the frequency of detections. The Human Health SEC is exceeded by the maximum concentrations of OCPs and chromium. Approximately 6,300 BCY of soils in this subgroup are considered principal threat exceedances. However, average concentrations for all COCs except aldrin (250 ppm) and dieldrin (46 ppm)

are below the Human Health SEC. OCPs and mercury exceed the Biota SEC at maximum concentrations ranging from 0.93 ppm for endrin to 52 ppm for aldrin. The 140,000 BCY of biota exceedance soils contain OCPs and mercury at concentrations above the Biota SEC (Figure 17.4-1).

The habitat within the South Plants Ditches Subgroup is poor based on the vegetation types encountered. The areas disturbed during remediation are revegetated with native grasses, so the overall habitat value is improved through remedial actions. This subgroup is considered a potential source of surface-water contamination due to the proximity of contaminated soils to surface water in the ditch. The remediation of the soils in these ditches, however, would prevent the possible migration of contaminants to surface water during precipitation events. This subgroup is not considered a source of groundwater contamination.

17.5 SOUTH PLANTS DITCHES SUBGROUP EVALUATION OF ALTERNATIVES

The five alternatives for the South Plants Ditches Subgroup vary in approach from no action to treatment. The retained alternatives from the DSA were modified to account for the treatment of principal threat volumes and to clarify the nomenclature to indicate that solidification is not required following treatment of organic contaminants. The alternatives were modified as follows: the containment alternative (Alternative 6b) was modified to include consolidating the exceedances within the Central Processing Area for containment; the vacuum extraction alternative (Alternative 16) was removed from consideration for this subgroup as VOCs, which are the focus of this alternative, do not comprise a significant portion of the exceedance volume; the in situ thermal treatment alternative (Alternative 19a) was not evaluated since the equipment for RF heating is not amenable to the physical configuration of the ditches; and the in situ and direct treatment alternative (Alternative 20), consisting of multiple technologies that predominantly address surficial contamination, was not evaluated for this subgroup since most of the contamination is not located in the surficial soils. Alternative 6: Caps/Covers was added to the evaluation of alternatives for this subgroup. This alternative addresses the containment of the entire South Plants Medium Group as a whole. The following subsections present a

description of each retained alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address areas of human health exceedances (which is listed first) and a biota alternative to address biota exceedances (the "B" alternative).

17.5.1 Alternative 1/B1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), applies to all 93,000 SY of exceedance area in the South Plants Ditches Subgroup. The 200,000 BCY of human health and biota exceedance volume remain in place without the implementation of controls. No actions are taken to reduce potential human or biota exposure to COCs or to reduce the potential for surface-water contamination from the ditches. Exceedance areas are monitored (an average of 16 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 17.5-1 presents a evaluation of Alternative 1 against the EPA criteria for the DAA. This alternative does not achieve Human Health or Biota RAOs as untreated soils remain in place. The residual risk is moderate due to the moderate levels of contamination remaining in the soil. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The quality of habitat at the sites is not changed and the potential migration of contaminants to surface water is not reduced. The total estimated present worth cost of this alternative is $1,100,000. Table B4.15-1 details the costing for this alternative.

17.5.2 Alternative 1a/B1: Direct Thermal Desorption of Principal Threat Volume; No Additional Action

Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), involves treatment of 6,300 BCY of principal threat exceedances in the South Plants Ditches Subgroup. Dewatering is not required for safe excavation based on the

anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed. The principal threat volume is excavated and transported to the centralized thermal desorption facility for treatment. (Section 4.6 discusses thermal desorption in detail.) The soils in this subgroup are classified as dry (i.e.,moisture content of 10 percent). Based on this moisture content, the soils are processed through the desorber at a rate of approximately 2,000 BCY/day and the solids are discharged at a temperature of 300°C with a total soils residence time of 30 minutes. The thermal desorber requires 1 year to build, and an additional year is required for testing prior to operation. Particulates from the scrubber blowdown, amounting to approximately 1 percent of the soils feed (63 BCY), are disposed into the on-post hazardous waste landfill. The treated soils are returned as backfill to the sites. Thermal desorption removes much of the organic content of the soil, so the 12,000 SY of disturbed area is covered with 6 inches of topsoil obtained off post and revegetated with native grasses.

The 190,000 BCY of remaining human health and biota exceedances in the South Plants Ditches Subgroup fall under the no additional action part of the alternative. No action is taken to reduce human or biota exposure to COCs or potential surface-water contamination. Based on the average contaminant concentration, treatment of the principal threat area achieves Human Health SECs; however, low residual risk is still present for biota. Exceedance areas are monitored (an average of 16 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 17.5-2 evaluates the alternative against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved under this alternative as untreated soils remain in place. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The highest levels of contamination are removed by treating the principal threat volumes, so there is a low residual risk for human exposure. The time frame to complete the alternative is 3 years due to the time required for construction and testing of the centralized thermal desorption facility. The poor-quality habitat in the balance of areas is not changed, although it is improved in the principal threat areas. The potential migration of contaminants to surface water is not reduced.

The total estimated present worth cost of this alternative is $1,800,000. Table B4.15-1a details the costing for this alternative.

17.5.3 Alternative 3/B3: Landfill

For the South Plants Ditches Subgroup, Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill), consists of excavating 200,000 BCY of contaminated soils for disposal in a centralized on-post landfill. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed.

The construction of the first cell of the multiple cell landfill and associated facilities requires 1 year. (Section 4.6 discusses the details of landfill construction.) The excavations are backfilled with borrow soils from the on-post borrow area to return the site to its original grade. Topsoil, obtained off post, is placed over the backfilled area and revegetated with native grasses to improve the habitat quality at the site. The borrow area is also recontoured and revegetated to restore habitat. After the disposal of the contaminated material is complete, the landfill cover is installed and the area revegetated. Fencing and biota barriers eliminate habitat at the landfill. The landfill requires long-term maintenance, leachate collection and treatment, and monitoring of potential leachate migration.

Table 17.5-3 provides a detailed evaluation of the alternative against the EPA criteria for the DAA. This alternative achieves RAOs since the contaminated soils are excavated and transferred to a containment cell. The habitat is improved at the site following remediation and restored at the borrow area. The disposal of the 200,000 BCY of human health and biota volumes requires approximately 2 years, based on the 1-year construction time frame for the landfill cell. The removal of the contaminated soils from the ditches reduces the potential migration of contaminants to surface water. The total estimated present worth cost of this alternative is $11,000,000. Table B4.15-3 details the costing for this alternative.

17.5.4 Alternative 6/B5: Caps/Covers

Alternative 6: Caps/Covers (Clay/Soil Cap), in combination with Alternative B5: Caps/Covers (Clay/Soil Cap), involves the containment of the entire South Plants Medium Group (1,700,000 SY), which includes the 93,000 SY of human health and biota exceedance area included in the South Plants Ditches Subgroup. A schematic of the South Plants Medium Group Cap is shown in Figure 17.2-1. (Section 4.6 discusses low-permeability soil caps in detail.) Before any cover materials are installed, existing structures are demolished and either contained in place or consolidated, the subgrade compacted, and the surface crowned with 260,000 BCY of borrow material (depending on Final grade) to achieve the design grades of 1.5 to 3 percent. The cap consists of a 2-ft layer of compacted low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil obtained off post. The cap is revegetated and burrowing animals are excluded to prevent damage to the containment system. The borrow area is recontoured and revegetated. Maintenance activities, such as grass mowing and replacement of eroded cap materials, ensures the continued integrity of the soil cover. Five-year site reviews are conducted to review the effectiveness of the alternative and to assess potential migration of contaminants.

Table 17.5-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through containment. The cap reduces the potential for migration of contaminants to surface water and interrupts exposure pathways for human health and biota. The capping operations take approximately 1 year to complete, and habitat is improved at the site after remediation, although burrowing animals are excluded from the area. Long-term maintenance is required to ensure the integrity of the cap. The total estimated present worth cost of this alternative is $10,000,000. Table B4.15-6 details the costing for this alternative.

17.5.5 Alternative 6b/B5a: Direct Thermal Desorption of Principal Threat Volume; Caps/Covers with Consolidation

Alternative 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation and Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation address the treatment of 6,300 BCY of principal threat exceedance soils and the containment of 190,000 BCY of human health and biota exceedance soils. The principal threat volume is excavated and transported to the centralized thermal desorption facility. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed.

The soils in this subgroup are classified as dry (i.e., moisture content of 10 percent). Based on this moisture content, the soils are processed through the desorber at a rate of approximately 2,000 BCY/day and discharged at a temperature of 300°C with a total residence time of 30 minutes. (Section 4.6.23 discusses emission controls for off gases from thermal desorption.) The 63 BCY of particulates from the scrubber blowdown, approximately 1 percent of the total soils feed, is placed into the on-post hazardous waste landfill. The treated soils are returned to the site as backfill. Thermal desorption removes much of the organic content in the soils, so the 93,000 SY of disturbed area (including the capped area) is covered with 6 inches of topsoil obtained off post and revegetated with native grasses.

The remaining 190,000 BCY of soils are consolidated in the Central Processing Area for containment. The selection of this alternative is predicated on the selection of Alternative 6a: Direct Thermal Desorption and Direct Solidification/Stabilization of Principal Threat Volume; Caps/Covers for the Central Processing Area Subgroup. Borrow soil from the on-post borrow area is backfilled into the sites, returning them to original grade. The borrow area is recontoured and revegetated restoring the habitat. Site remediation is completed by revegetating the 6-inch layer of topsoil that has been obtained off post with native grasses. A clay/soil cap at the Central Processing Area provides a physical barrier to protect human and biota receptors from directly

contacting exceedance soils. Maintenance operations at the Central Processing Area ensure the integrity of the clay/soil cap, but no maintenance operations are required at the site because all exceedance soils are removed or treated.

Table 17.5-5 evaluates the alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through treatment of principal threat volume and consolidation of exceedance soils at the Central Processing Area. The potential for migration of contaminants to surface water is reduced and exposure pathways are interrupted. Biota disturbance is minimal due to existing poor-quality habitat. Long-term monitoring includes maintenance of the clay/soil cap at the Central Processing Area and at the landfill for the particulates. The total estimated present worth cost of this alternative is $6,300,000. Table B4.15-6b presents the detailed cost estimate for this alternative.

17.5.6 Alternative 13a/B6: Direct Thermal Desorption

Alternative 13a: Direct Thermal Desorption (Direct Heating), paired with Alternative B6: Direct Thermal Desorption (Direct Heating), treats 200,000 BCY of soils primarily contaminated with OCPs from the South Plants Ditches Subgroup. Human health and biota exceedance soils are excavated for treatment at the centralized thermal desorption facility. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed.

Section 4.6 discusses the details of thermal desorption. Assuming a soil moisture content of 10 percent, the thermal desorber processes approximately 2,000 BCY/day with a discharge temperature of 300°C and a total soils residence time of 30 minutes. When operating under these conditions, the thermal desorber volatilizes all of the mercury and some of the arsenic present in the contaminated soils. Therefore, solidification of the treated soil is not anticipated to be required. The thermal desorber requires 1 year to build and an additional year for testing. (Section 4.6.23 discusses emission controls for off gases from thermal desorption.)

The 2,000 BCY of blowdown particulates, approximately 1 percent of the soils feed, are placed in the on-post hazardous waste landfill due to the arsenic and mercury content. The treated soils are returned to the site and backfilled. Since thermal desorption destroys the natural organic content of the soils, topsoil obtained off post is placed on the backfilled area of 93,000 SY and is revegetated with native grasses.

Table 17.5-6 evaluates Alternative 13a against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs since all contaminated soils are treated to remove or destroy the exceedance COCs. The habitat is improved at the site following remediation, and the potential migration of contaminants to surface water is reduced. The thermal desorption of 200,000 BCY of contaminated soils require 3 years, including 2 years for the construction and testing of the thermal desorption facility. The total estimated present worth cost of this alternative is $25,000,000. Table B4.15-13a details the costing for this alternative.

17.6 SOUTH PLANTS DITCHES SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The South Plants Ditches Subgroup contains 200,000 BCY of exceedance volume. OCPs, chromium, and mercury are the primary exceedances. Contamination is a result of surface-water runoff from manufacturing and processing activities in South Plants. Approximately 6 percent of the samples contained OCPs above the Human Health SEC, and an additional 15 percent of the samples show detections of OCPs above the Biota SEC. Average concentrations in the human health exceedance volume are less than the Human Health SEC for all COCs except aldrin and dieldrin. Average concentrations in the biota exceedance volume are higher than the Biota SEC for most of the OCPs.

The principal threat criteria for aldrin and dieldrin are exceeded by 6 percent of the samples, producing a principal threat volume of 6,300 BCY. Agent, UXO, and groundwater contamination are not associated with this subgroup, but migration of contaminants to surface water flowing through the ditches is possible.

The area within the subgroup has poor quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration following remediation, so no significant habitat impacts are expected, although alternatives that involve containment with a cap/cover require the exclusion of burrowing animals.

Alternatives that involve excavation of human health exceedances require protection for site workers during remedial activities, but the short-term risk to workers is minimal with the use of proper PPE. The degree of contamination in sites in this subgroup does not necessitate special measures for odor control or community protection during remediation.

In summary, the South Plants Ditches Subgroup contains levels of contamination that exceed Human Health and Biota SEC, and has limited areas that also exceed principal threat criteria. There is potential for surface-water contamination from this subgroup. Habitat impacts and community protections are not significant issues for consideration in selecting the preferred alternative.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs as untreated soils remain on site, and so is eliminated from further consideration as the preferred alternative. Alternative 1a: Direct Thermal Desorption of Principal Threat Volume; No Additional Action treats the highest levels of contamination, but still does not achieve Human Health or Biota RAOs and is also eliminated from further consideration. The remaining four alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action-specific and location-specific ARARs for the DAA.

Alternative 13a: Direct Thermal Desorption exhibits a higher cost ($25,000,000) than the like Alternative 6b: Direct Thermal Desorption of Principal Threat Volume; Caps/Covers, with Consolidation ($6,300,000) because the entire exceedance area rather than the principal threat volume alone is treated under the former alternative. These alternatives both use thermal desorption to achieve RAOs to varying degrees. Alternative 3: Landfill uses containment rather

than treatment to reduce contaminant mobility, but also requires the excavation of the entire exceedance area. This alternative achieves RAOs and has a cost of $11,000,000. Alternative 6: Caps/Covers also achieves RAOs through containment, but is dependent on the selection of Alternative 6: Caps/Covers for the remaining subgroups in South Plants.

The preferred alternative for the South Plants Ditches Subgroup is Alternative 6b: Direct Thermal Desorption of Principal Threat Volume; Caps/Covers with Consolidation. This is the most cost-effective alternative for this subgroup since only the principal threat volume is treated, and it has the lowest cost of the protective alternatives. Alternative 6b also reduces the overall remediation costs at RMA as the material removed from the sites within this subgroup is consolidated in the Central Processing Area before the installation of a cap/cover to provide grading fill. As a result, the area to be maintained, as well as long-term monitoring and maintenance costs, at RMA are reduced. This alternative is consistent with NCP guidance on the use of treatment technologies for higher levels of contamination and engineering controls for lower levels of contamination.

17.7 SOUTH PLANTS TANK FARM AREA SUBGROUP CHARACTERISTICS

The South Plants Tank Farm Subgroup is composed of sites SPSA-2a (South Tank Farm) and SPSA-2b (Open Storage Yard) (Figure 17.0-1). These sites contain soils that were contaminated by releases from the tank farm area. The soils in this subgroup are not anticipated to contain agent and the principal threat criteria are not exceeded. The South Tank Farm Plume IRA investigated the extent of the light nonaqueous phase liquid (LNAPL) emanating from these sites and initiated the removal and treatment of the LNAPL.

Table 17.7-1 provides a summary of contaminants, concentrations, and corresponding exceedance values for the subgroup and Table 17.7-2 summarizes the frequency of detection. DCPD is the only human health COC in the subgroup and is present at concentrations below the Human Health SEC. The 210,000 BCY human health exceedance volume is based on an exceedance of the indirect exposure PPLVs for DCPD of 2.4 ppm (EBASCO 1992d/RIC 92275R02). These soils also contain dieldrin and endrin at maximum concentrations (4.1 ppm and 0.042 ppm,

respectively) that exceed Biota SEC only. These OCPs were detected at depths ranging from 0 to 5 ft, although most of the contaminated soils are located between 0 and 1 ft below ground surface. Figure 17.7-1 shows the distribution of exceedance areas for the South Plants Tank Farm Subgroup soils.

This subgroup is poor-quality habitat based on the types of vegetation encountered. The areas disturbed during remediation are revegetated with native grasses, so the overall habitat value is improved through remedial actions, although alternatives that involve containment with a cap/cover require the exclusion of burrowing animals.

The South Plants Tank Farm Subgroup is identified as the source of a groundwater contamination plume that may contain LNAPL. This plume occurs in the unconfined aquifer and extends to the south of the site. Groundwater alternatives for the South Plants Plume Group that address the removal of the LNAPL through the ongoing IRA or the mass reduction of individual plume groups are being evaluated. Coordination of those alternatives developed for the soils medium with those developed for the water medium is limited to excavation or capping, although the in situ treatment of soils might enhance groundwater removal. Due to the contaminant mass already in the aquifer, it is unlikely that the remediation of the South Plants Tank Farm Subgroup would modify the evaluation of groundwater alternatives for the South Tank Farm Plume, although the remedial alternative selected for soils might favor a specific groundwater alternative. For example, the removal of VOCs from soils through in situ vapor extraction is more efficient when all of the LNAPL is removed, and soil vapor extraction/air sparging would compliment an in situ biological treatment alternative for the dissolved contaminants in the groundwater.

The contaminated soils in this subgroup are overlain by several tanks, which are included in the No Future Use Manufacturing History–Process History Subgroup in the structures medium. The landfilling or direct treatment of contaminated soils beneath these tanks requires the demolition of the tanks and removal of the debris. The in situ treatment of VOCs through vacuum extraction (Alternative 16a) does not necessitate the demolition and removal of these tanks;

however, the vacuum extraction system would be more efficient if the optimal well spacing is not compromised by the tanks. The capping of soils within the South Plants Tank Farm also requires the demolition of structures, but the structural debris from these tanks can be contained beneath the cap.

17.8 SOUTH PLANTS TANK FARM SUBGROUP EVALUATION OF ALTERNATIVES

The six alternatives for the South Plants Tank Farm Subgroup vary in approach from no action to treatment. The retained alternatives from the DSA were modified both to account for treatment of surficial contamination and to clarify the nomenclature to indicate that solidification/stabilization is not required following the treatment of organic contaminants (Alternative 16 versus 16a). The modified alternative, Alternative 20, consists of multiple in situ and direct treatment technologies used to address areas with predominantly surficial contamination. This alternative was not evaluated for the subgroup since the contamination is located throughout the vadose zone. In addition, Alternative 5 was changed to Alternative 6 to eliminate the use of slurry walls to address groundwater contamination. Slurry walls were removed from this subgroup so as not to interfere with groundwater alternatives evaluated for the South Plants Tank Farm Plume in the Water DAA. In addition, Alternative 6 addresses the containment of the South Plants Medium Group as a whole. The following subsections present a description of each retained alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address areas of human health exceedances (which is listed first) and a biota alternative to address biota exceedances (the "B" alternative).

17.8.1 Alternative 1/B1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), applies to all 94,000 SY of exceedance area in the South Plants Tank Farm Subgroup. The 240,000 BCY of human health and biota exceedance volume remains in place. No actions beyond the ongoing South Tank Farm Plume IRA are taken to

reduce potential human or biota exposure to COCs. Exceedance areas are monitored (an average of 16 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 17.8-1 presents an evaluation of Alternative 1 against the EPA criteria for the DAA. This alternative is protective of human health due to the reduction in groundwater contamination as a result of the ongoing South Tank Farm Plume IRA, which reduces the vapor emissions from the LNAPL. Biota RAOs are not achieved because shallow contamination is left in place without controls. The residual risk is low due the low levels of contamination for both Human Health and Biota COCs. Natural attenuation of untreated soils is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The poor-quality habitat at the sites is not changed and the continued migration of contaminants to groundwater is not addressed. This alternative does not impact structures and consequently does not preclude the selection of any alternatives for the structures medium. The total estimated present worth cost of this alternative is $1,100,000. Table B4.16-1 details the costing for this alternative.

17.8.2 Alternative 3/B3: Landfill

Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill), consists of landfilling 240,000 BCY of human health and biota exceedances for the South Plants Tank Farm Subgroup. The contaminated soils are excavated and placed in an on-post landfill. The existing structures are demolished to allow the excavation of contaminated soils. The structural debris and the buried utilities are removed during excavation and consolidated off site. To control odor emissions during excavation, only minimal area is exposed at any one time, and a daily soil cover or plastic liner is placed over the excavations to further control odor emissions. The construction of the first cell of the multiple cell landfill and associated facilities takes 1 year. (Section 4.6 discusses details of landfill construction.) The site excavations are backfilled with borrow materials from an on-post borrow area to return the site to grade. To improve the habitat quality at the site, topsoil is placed over the backfilled area and is revegetated with native grasses. The borrow area is also recontoured and revegetated to restore

habitat. After the waste is emplaced, the landfill cover is installed and revegetated, and fencing and biota barriers exclude biota from the landfill site. The landfill requires long-term maintenance, leachate collection and treatment, and monitoring of potential leachate migration.

Table 17.8-2 presents an evaluation of Alternative 3 against the EPA criteria for the DAA. This alternative achieves RAOs since the contaminated soils are excavated and transferred to a containment cell. The habitat is improved at the site following remediation and is restored at the borrow area. The removal of the contaminated soils prevents the migration of contaminants to groundwater. Disposal of the 240,000 BCY of human health and biota volumes takes approximately 2 years. The total estimated present worth cost of this alternative is $14,000,000. Table B4.16-3 details the costing for this alternative.

17.8.3 Alternative 6/B5: Caps/Covers

Alternative 6: Caps/Covers (Clay/Soil Caps) along with Alternative B5: Caps/Covers (Clay/Soil Cap), addresses the containment of 240,000 BCY of human health and biota exceedances for the South Plants Tank Farm Subgroup by installing a 1,700,000-SY clay/soil cap over the entire South Plants Medium Group. The demolition of the tanks is required prior to the installation of the cap; however, the structural debris from these tanks can be contained as grading fill for the cap.

Prior to construction of the clay/soil cap, the subgrade is compacted to eliminate variations in the subgrade and the surface is crowned with 160,000 BCY of borrow material to achieve design grades and facilitate surface-water runoff. (Section 4.6 discusses clay/soil caps in detail.) The area is then covered by a 2-ft-thick compacted low-permeability soil layer, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. Revegetation with native grasses completes the alternative. The cover provides a physical barrier protecting human and biota receptors from directly contacting the contaminated soils. Fill materials for the cap and slurry wall mixture are excavated from the borrow area in the northern portion of Section 30 and the topsoil is obtained off post. After the borrow area is recontoured, the habitat is restored

through revegetation. Maintenance activities and restrictions to burrowing animals ensure the integrity of the clay/soil cover.

Table 17.8-3 evaluates the alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs through containment. The potential for increased migration of contaminants to groundwater is reduced by reducing infiltration through the installation of a cap/cover. The habitat is improved at the site following remediation, but remains restricted for burrowing animals. The capping operations require 1 year to complete, and long-term maintenance is required to ensure the integrity of the cap. The total estimated present worth cost of this alternative is $8,800,000. Table B4.16-6 details the costing for this alternative.

17.8.4 Alternative 13a/B6: Direct Thermal Desorption

For the South Plants Tank Farm Subgroup, Alternative 13a: Direct Thermal Desorption (Direct Heating), paired with Alternative B6: Direct Thermal Desorption (Direct Heating), treats 240,000 BCY of contaminated soils that primarily contain DCPD (as an indirect vapor exposure pathway exceedance) and OCPs. The excavation of the contaminated soils necessitates the demolition of the tanks and the removal of the resulting debris. Buried utilities are removed and consolidated with the structural debris. During excavation only a minimal area is exposed at any one time, and a daily soil cover or plastic liner is placed over the excavations to control odor emissions.

Exceedance soils are excavated and transported to the centralized thermal desorption facility for treatment. (Section 4.6 discusses the details of thermal desorption.) The soils in this subgroup are classified as dry (i.e., moisture content of 10 percent). Based on this moisture content, the thermal desorber has a soils processing rate of approximately 2,000 BCY/day, operates with a discharge temperature of 300°C, and has a total soils residence time of 30 minutes. (Section 4.6.23 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the total soils feed (2,400 BCY) is recovered from the scrubber blowdown equipment and is placed in the on-post landfill. Solidification of the treated soils is not required since inorganic contaminants do not exceed Human Health or Biota SEC. The treated soils are

returned to the site excavations as backfill. Since thermal desorption destroys the natural organic content in the soils, topsoil obtained off post is placed on the backfilled area of 94,000 SY and revegetated with native grasses to improve the overall habitat quality of the site.

Table 17.8-4 evaluates Alternative 13a against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs since all contaminated soils are treated to remove or destroy the exceedance COCs. Following remediation, the habitat is improved at the site and the migration of contaminants to groundwater is reduced. Thermal desorption of 240,000 BCY of contaminated soils takes approximately 3 years, including 2 years for construction and testing of the facility. The total estimated present worth cost of this alternative is $30,000,000. Table B4.16-13a details the costing for this alternative.

17.8.5 Alternative 16a/B9: In Situ Physical/Chemical Treatment

Alternative 16a: In Situ Physical/Chemical Treatment (Vacuum Extraction), paired with Alternative B9: In Situ Biological Treatment (Landfarm/Agricultural Practice), addresses the 240,000 BCY of exceedance soils within this subgroup. Prior to treatment, the existing structures are demolished and the debris removed, which limits the alternatives currently being evaluated for structures in this area. The vacuum extraction portion of the alternative extracts VOC-laden vapors present in the unsaturated soils and treats them at the surface. (Section 4.6 discusses vacuum extraction in detail.) DCPD is volatilized and removed by inducing an air flow through extraction wells in the contaminated zone. The operating life of the vacuum extraction system is 10 years and the system achieves more than 90-percent removal of VOCs in the soil (Section 4.6.27). There are 720 wells installed throughout the 73,000 SY exceedance area for DCPD based on a radius of influence of 35 ft per well. Since the surficial soils are not impacted by soil vapor extraction, the exceedance area does not require revegetation.

The removal of VOCs through vacuum extraction does not require the demolition of the tanks since the radius of influence for the extraction wells (35 ft) indicates that extraction wells could be located around a tank to adequately remove VOCs. In addition, one or more horizontal wells

could also be installed beneath a tank to improve the efficiency of the vapor extraction. However, modifying the well spacing reduces the overall efficiency of the vacuum extraction system. As such, it may be more cost effective to demolish and remove the tanks to maintain a consistent well spacing.

The biota exceedance area of 21,000 SY is treated through landfarm/agricultural practice, which consists of plowing the uppermost 18 inches of the exceedance area to reduce the mobility and toxicity of the contaminants in the surficial soils. Agricultural studies have demonstrated degradation of OCPs in soils subjected to landfarming. Furthermore, the treatment results in fewer short-term impacts to biota as the areas treated are easily revegetated. The habitat quality is improved by revegetation with native grasses. Long-term soil monitoring and 5-year site reviews are performed over the treated area to observe the potential migration of contaminants into subsurface soils and the natural attenuation/degradation of contaminants.

Table 17.8-5 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. The equipment for vacuum extraction and for landfarm/agricultural practice are commercially available, and both technologies are proven at full scale. The habitat is improved over 21,000 SY following landfarm/agricultural practice and revegetation. The remediation of the contaminated soils by this alternative reduces the migration of contaminants to groundwater and requires 10 years to achieve RAOs. The total estimated present worth cost of this alternative is $8,000,000. Table B4.16-16a details the costing for this alternative.

17.8.6 Alternative 19a/B9: In Situ Thermal Treatment

Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating) treats 210,000 BCY of human health exceedance soils that primarily contain DCPD as an indirect exceedance, while Alternative B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) addresses 21,000 SY of biota exceedance soils that primarily contain OCPs. The existing tanks in the South Plants Medium Group are demolished and removed prior to treatment, which limits alternatives currently being evaluated for structures in this area.

RF heating raises the temperature of the soil to more than 250°C, mobilizing the organic contaminants. The mobilized contaminants are then collected and treated in the off-gas treatment system (see Section 4.6). One RF unit is used for South Plants Tank Farm Subgroup. Contamination from 0 to 10 ft below ground surface in a 100-ft-long, 48-ft-wide block is treated at a rate of 180 BCY/day based on a soil moisture content of approximately 10 percent. The liquid sidestream from in situ heating, which contains predominantly salts, is transported to the centralized thermal desorption facility for treatment. A 6-inch layer of topsoil is then placed over the treated human health exceedance area of 73,000 SY to provide a growth medium for vegetation. Revegetation with natives grasses improves the overall habitat quality of the site. The effectiveness of RF heating is within the acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk); however, this technology leaves concentrations above the Biota SEC in place.

The biota exceedance area of 21,000 SY is treated through landfarm/agricultural practice, which consists of plowing the uppermost 18 inches of the exceedance area to reduce the mobility and toxicity of the contaminants in the surficial soils. Agricultural studies have demonstrated degradation of OCPs in soils subjected to agricultural practice. Furthermore, the treatment of this area by landfarming results in fewer short-term impacts to biota as the areas treated are easily revegetated. The habitat quality of this 21,000-SY area is improved following revegetation with native grasses. Long-term soil monitoring and 5-year site reviews are performed over the treated area to observe the potential migration of contaminants into subsurface soils and the natural attenuation/degradation of contaminants.

Table 17.8-6 evaluates Alternative 19a against the EPA criteria for the DAA. The implementability of RF heating is questionable since there is no commercial source for the equipment and the technique is as yet unproven at full scale. This alternative reduces the potential for migration of contamination to groundwater. RF heating of 210,000 BCY of contaminated soils is feasible within 4 years. The total estimated present worth cost of this alternative is $81,000,000. Table B4.16-19a details the costing for this alternative.

17.9 SOUTH PLANTS TANK FARM SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The South Plants Tank Farm Subgroup contains 240,000 BCY of exceedance volume attributed to releases from the tank farm area. No COCs exceed the Human Health SEC, but 13 percent of the samples for DCPD exceed the indirect exposure PPLV to account for 210,000 BCY of human health exceedance volume. Eight percent of the dieldrin and endrin samples exceed the Biota SEC, producing 32,000 BCY of biota exceedance volume. Average concentrations of dieldrin and endrin in the biota exceedance volume are below or slightly above the Biota SEC.

There are no UXO, agent, or principal threats associated with this subgroup, but the tank farm has been identified as the source of a groundwater contamination plume that include LNAPL. The ongoing South Plants Tank Farm IRA reduces groundwater contamination and removes LNAPLs.

The area within the subgroup has poor-quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration following remediation, so significant habitat impacts are expected, although alternatives involving containment with a caps/cover require the exclusion of burrowing animals.

Excavation of soils in the South Plants Tank Farm Subgroup requires health and safety protection for site workers. Due to the volatile nature of the contaminants, the area excavated at any one time is limited, and a daily soil cover or plastic liner is used to prevent odor emissions from impacting the community.

In summary, the South Plants Tank Farm Subgroup contains human health exceedances of the indirect vapor inhalation PPLV for DCPD and exceedances of the Biota SEC for OCPs. The subgroup is the source of a groundwater plume, but the ongoing IRA reduces groundwater contamination. Selection of the preferred alternative should consider the longer-term risks of

migration if contaminants remain in place against the short-term risks to workers and the community of excavation operations compared to in situ treatment.

Alternative 1: No Additional Action is protective of human health since the ongoing South Tank Farm Plume IRA reduces groundwater contamination and removes the LNAPL. The removal of the LNAPL reduces the flux of vapors in the soil. However, Biota RAOs are not achieved as shallow, untreated soils remain in place; this alternative is therefore eliminated from further consideration as the preferred alternative. The remaining five alternatives achieve RAOs, and meet two DAA threshold criteria: protection of human health and the environment and compliance with action-specific and location-specific ARARs in the DAA.

Alternative 19a: In Situ Thermal Treatment achieves Human Health RAOs through treatment, but the technology for RF heating is not available and is unproven at full scale. Since DCPD is a volatile contaminant, this alternative only reduces the time frame required for remediation as compared with soil vapor extraction. Alternative 19a: In Situ Thermal Treatment also exhibits the highest cost ($81,000,000) for the remaining alternatives. Alternative 6: Caps/Covers contains contaminants and interrupts exposure pathways but may not adequately reduce the mobility of VOCs. This alternative exhibits a higher cost ($8,800,000) than Alternative 3: Landfill, which excavates and contains the entire exceedance area without treatment. Alternative 13a: Direct Thermal Desorption excavates and treats the entire exceedance area. The cost for this alternative, $30,000,000, is in the middle of the range of costs for alternatives in this subgroup. Vapor and odor controls are required during excavation for Alternatives 3: Landfill and 13a: Direct Thermal Desorption. Alternative 16a: In Situ Physical/Chemical Treatment removes the VOCs from the soils for treatment at the lowest cost ($8,000,000) of the remaining alternatives. This alternative requires 10 years to remove the VOCs and achieve RAOs.

The preferred alternative for the South Plants Tank Farm Subgroup is Alternative 16a: In Situ Physical/Chemical Treatment. This technology is the most cost effective in removing VOCs and

is consistent with NCP guidance on treating the more mobile contaminants. This alternative is also cost effective in the remediation of OCPs in surficial soils. The removal of VOCs through vacuum extraction does not require the demolition of the tanks. The radius of influence for the extraction wells (35 ft) indicates that extraction wells could be located around the tanks to adequately remove VOCs. In addition, one or more horizontal wells could be installed beneath the tanks to improve the efficiency of the vapor extraction. Modifying the well spacing reduces the overall efficiency of the vacuum extraction system, however. As such, it may be more cost effective to demolish and remove the tanks to maintain a consistent well spacing. In addition, Alternative 16a complements the groundwater pump-and-treat system that is part of the preferred alternative for the South Tank Farm Plume. Coordination of soils remedial activities with those for the water medium ensures that the LNAPL is removed prior to soils remediation, facilitating the performance of the vacuum extraction system.

17.10 SOUTH PLANTS BALANCE OF AREAS SUBGROUP CHARACTERISTICS

The South Plants Balance of Areas Subgroup is composed of sites SPSA-1b (Mounded Material), SPSA-1c (Lime Pits), SPSA-1g (Balance of Subarea), SPSA-2c (Salvage Yard), SPSA-2e (Balance of Subarea), SPSA-3b (Salt Storage Pad), SPSA-3c (Former Tank Storage Area), SPSA-3d (Revetted Tank Storage), SPSA-3e (Balance of Subarea), SPSA-4b (Balance of Subarea), SPSA-5b (Balance of Subarea), SPSA-7b (Lagoon), SPSA-7c (Balance of Subarea), SPSA-8a (Sanitary Landfill), SPSA-9b (Balance of Subarea), SPSA-12a (Aeration Basin), and SPSA-12b (Sedimentation Pond) (Figure 17.10-1.) These sites contain soils that were contaminated as a result of miscellaneous operations in the South Plants study area. There are 43,000 SY of soils with potential agent presence, and 15,000 SY of soils, primarily in the southern portion of South Plants, with potential UXO presence (Table 17.0-1).

Table 17.10-1 provides a summary of contaminants, concentrations, and exceedance values for this subgroup and Table 17.10-2 summarizes the frequency of detections. There are 150,000 BCY of soils in this subgroup that contain OCPs, HCCPD, and chromium at maximum concentrations above the Human Health SEC. The maximum concentrations of aldrin, dieldrin,

and chlordane (15,000 ppm, 2,600 ppm, and 730 ppm, respectively) also exceed the principal threat criteria (10^{-3} excess cancer risk, HI of 1,000) in 19,000 BCY of soils. OCPs were found from 0 to 10 ft below ground surface; however, a majority of the exceedances were detected in the 0- to 2-ft depth interval. ICP metals were detected at only a few locations at depths from 0 to 7 ft below ground surface. There are 570,000 BCY of soils that contain maximum concentrations of OCPs, arsenic, and mercury exceeding the Biota SEC. These COCs were detected at depths from 0 to 10 ft below ground surface, but were predominantly found in the 0- to 1-ft depth interval. Figure 17.10-2 presents the overlap between areas potentially containing agent or UXO and the exceedance areas.

The South Plants Balance of Areas Subgroup is poor-quality habitat based on the types of vegetation encountered. The areas disturbed during remediation are revegetated with native grasses, so the overall habitat value is improved through remedial actions, although alternatives involving containment with a cap/cover require the exclusion of burrowing animals.

Sites in the South Plants Balance of Areas Subgroup are identified as being the source of several groundwater contamination plumes. These plumes occur in the unconfined aquifer and migrate away from the Central Processing Area. Groundwater alternatives that address the installation of individual plume group remediation systems are being evaluated. Coordination of alternatives developed for the soils medium with those developed for the water medium is limited to excavation or capping. In situ soil treatment can complement groundwater alternatives by reducing contamination. Due to the contamination mass already in the aquifer, it is unlikely that the remediation of this subgroup would impact the groundwater quality in the near term, but it would prevent additional contaminant loading of the groundwater. Excavation and capping alternatives require the demolition of structures and removal of debris. All structural debris must then be transported out of the area for disposal in South Plants Central Processing Area or a landfill as discussed in Chapter 6 of the Structures DAA.

17.11 SOUTH PLANTS BALANCE OF AREAS SUBGROUP EVALUATION OF ALTERNATIVES

The seven alternatives developed for the South Plants Balance of Areas Subgroup vary in approach from no action to treatment. The retained alternatives from the DSA were modified to account for the treatment of principal threat volumes as follows: the containment alternative (Alternative 6b) was modified to include consolidating the contaminated soils at the Central Processing Area for eventual containment, and the vacuum extraction alternative (Alternative 16) was removed from consideration for this subgroup as VOCs, which are the focus of this treatment, are not considered significant for this subgroup. Alternative 6: Caps/Covers was added to the evaluation of alternatives for this subgroup. This alternative addressees the containment of the entire South Plants Medium Group as a whole. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address areas of human health exceedances (which is listed first) and a biota alternative to address biota exceedances (the "B" alternative), an alternative to address potential agent presence (the "A" alternative), and an alternative to address potential UXO presence (the "U" alternative).

17.11.1 Alternative 1/B1/A1/U1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), Alternative A1: No Additional Action (Provisions of FFA), and Alternative U1: No Additional Action (Provisions of FFA), applies to all 620,000 SY of exceedance area in the South Plants Balance of Areas Subgroup. The 720,000 BCY of soils with human health and biota exceedances as well as the potential for agent and UXO remain in place. No action is taken to reduce potential human or biota exposure to COCs, physical and acute chemical hazards from agent and UXO, or migration of contaminants to groundwater from these sites. Exceedance areas are monitored (an average of 82 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants. This alternative complies with the provisions of the FFA.

Table 17.11-1 presents an evaluation of Alternative 1 against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved under this alternative as untreated soils remain in place without controls being initiated. Natural attenuation of untreated soils is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The residual risk is moderate due to the moderate levels of contamination in the soils and the potential presence of agent and UXO. Groundwater contamination from these sites is not addressed by this alternative. This alternative does not impact structures and consequently does not preclude the selection of any alternatives developed for the structures medium. The poor-quality habitat at the site is not changed. The total estimated present worth cost of this alternative is $5,000,000. Table B4.17-1 details the costing for this alternative.

17.11.2 Alternative 1a/B1/A1/U1: Direct Thermal Desorption of Principal Threat Volume; No Additional Action

Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), Alternative A1: No Additional Action (Provisions of FFA), and Alternative U1: No Additional Action (Provisions of FFA), involves treatment of 19,000 BCY of principal threat exceedances in the South Plants Balance of Areas Subgroup. The principal threat area is cleared of UXO using geophysical screening and screened for agent using real-time field analytical methods prior to excavation. Any soils confirmed to contain agent by RMA laboratory analysis are treated on-post by rotary kiln incineration (Alternative A4). If UXO are detected, they are excavated, packaged, and transported off post for demilitarization at an Army facility (Alternative U4a). Once the principal threat area is cleared, principal threat exceedance soils are excavated and transported to the centralized thermal desorption facility for treatment. (Section 4.6 discusses the details of thermal desorption.)

The demolition of structures is required to allow the excavation of contaminated soils. The structural debris is removed from the site along with any abandoned utilities encountered during excavation. Dewatering is not required for safe excavation based on the anticipated decrease in

water levels once man-made recharge sources (i.e., leaking water lines) are removed. Due to the potential odor problems, excavation is conducted so that only minimal area is uncovered and exposed at any one time, and a daily soil cover or plastic liner is installed over the excavated areas.

The soil for this subgroup is classified as dry (i.e., moisture content of 10 percent). Based on the moisture content, the thermal desorber processes the soils at a rate of approximately 2,000 BCY/day and discharges them at a temperature of 300°C after a total soils residence time of 30 minutes. (Section 4.6.23 discusses emission controls for off-gases from thermal desorption.) Particulates from scrubber blowdown, amounting to approximately 1 percent of the total soils feed (190 BCY), are placed into the on-post hazardous waste landfill. Treated soils are returned and backfilled into the excavations. Thermal desorption removes much of the organic content in the soils, so the disturbed area is covered with 6 inches of topsoil obtained off post and revegetated with native grasses.

The 700,000 BCY of remaining exceedance soils from the balance of the site fall under the no additional action portion of the alternative. No action is taken in these areas to reduce potential human or biota exposure to COCs, physical and acute chemical hazards from agent or UXO, or potential groundwater contamination from sites in this subgroup. However, based on the average concentration, treatment of the principal threat area reduces concentrations to meet both the Human Health and Biota SEC. Exceedance areas left in place are monitored (an average of 82 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 17.11-2 presents an evaluation of Alternative 1a against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved under this alternative as untreated soils remain in place without controls being initiated. Natural attenuation of untreated soils is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. Although the highest levels of contamination in principal threat areas are treated, the residual risk is moderate due to the

potential presence of agent and UXO. This alternative complies with provisions of the FFA. The time frame for completion of the alternative is 3 years, including 2 years for construction and testing of the centralized thermal desorption facility. The overall poor-quality habitat at the sites is not changed and the migration of contaminants to groundwater is not reduced. The total estimated present worth cost of this alternative is $7,100,000. Table B4.17-1a details the costing for this alternative.

17.11.3 Alternative 3/B3/A4/U4a: Landfill

For the South Plants Balance of Areas Subgroup, Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill), Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4a: Detonation (Off-Post Army Facility), consists of landfilling 720,000 BCY of contaminated soils. The demolition of structures is required to allow the excavation of contaminated soils. The structural debris is removed from the site along with any abandoned utilities encountered during excavation. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed. Due to the potential odor problems, excavation is conducted so that only minimal area is uncovered and exposed at any one time, and a daily soil cover or plastic liner is installed over the excavated areas.

This subgroup includes 43,000 SY of area with potential agent presence and 15,000 SY of area with potential UXO presence. Prior to excavation, the area with potential UXO presence is cleared using geophysical screening techniques. Any identified UXO are excavated, packaged, and transported off post for demilitarization at an existing Army facility. The 5,000 BCY of metallic debris mixed with surface soils are excavated and placed in the on-post landfill.

Prior to excavation, the soil is screened for agent using real-time field analytical methods. If agent presence is confirmed by RMA laboratory analysis, the soil is excavated and transported to the on-post rotary kiln incinerator for treatment. It is assumed that there are approximately 140 BCY of agent-contaminated soils in this subgroup. (Section 4.6 discusses the details of

incineration.) Operating parameters of the incinerator include an operating temperature of 760°C, a soils residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off-gases from incineration.) Approximately 1 percent of the total soils feed (1 BCY) is recovered as particulates from the scrubber blowdown and is placed in the on-post hazardous waste landfill. The treated soils are returned to the site as backfill.

Once soils have been screened and cleared, they are excavated and placed in the on-post hazardous waste landfill. (Section 4.6 discusses the details of landfill construction.) The construction of the first cell of the multiple cell landfill and associated facilities requires 1 year. The site excavations are backfilled with borrow soils from the on-post borrow area to return the site to grade. Topsoil obtained off post is placed over the backfilled area and is revegetated with native grasses to improve the habitat at the site. The borrow area is also revegetated and recontoured to restore habitat. After placement of waste, the landfill cover is installed and vegetated, and access controls of fencing and biota barriers are implemented to restrict the site from burrowing animals. The landfill requires long-term maintenance of the cover, leachate collection and treatment, and groundwater monitoring.

Table 17.11-3 presents an evaluation of Alternative 3 against the EPA criteria for the DAA. This alternative achieves RAOs since the contaminated soils are excavated and transferred to a containment cell or incinerated. The habitat is improved at the site after remediation and restored at the borrow area, but eliminated at the landfill. The migration of contaminants to groundwater is reduced. The disposal of the 720,000 BCY of human health and biota exceedance volumes takes approximately 3 years based on the 1-year construction time frame for the landfill cell and the 2-year construction time frame required for the incinerator. The total estimated present worth cost of this alternative is $44,000,000. Table B4.17-3 details the costing for this alternative.

17.11.4 Alternative 6/B5/A2/U2: Caps/Covers

Alternative 6: Caps/Covers (Clay/Soil Cap), combined with Alternative B5: Caps/Covers (Clay/Soil Cap), Alternative A2: Caps/Covers (Clay/Soil Cap), and Alternative U2: Caps/Covers

(Clay/Soil Cap), addresses the containment of the entire South Plants Medium Group (1,700,000 SY), which includes the 620,000 SY of human health and biota exceedance area as well as agent and potential UXO presence areas associated with the South Plants Balance of Areas Subgroup and 700,000 SY outside of the exceedance areas to allow the containment of structural debris in place. Before any cover materials are installed, a surface sweep is conducted with a metal detector to ensure that UXO are not present in near surface soils, the existing structures are demolished and either contained in place or consolidated, the subgrade is compacted, and the surface crowned with 1,900,000 BCY of borrow material to control surface-water runoff. The human health, biota, agent, and potential UXO areas are covered by a 2-ft layer of low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. The capped area is then revegetated to restore the habitat. The fill materials for the cap are excavated from the on-post borrow area and topsoil is obtained off post. The capping operations take 2 years to complete. Maintenance activities (mowing and replacing eroded soils) ensure the continued integrity of the soil cap.

Table 17.11-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through containment. The potential for migration of contaminants to groundwater is reduced and exposure pathways are interrupted. Habitat is improved at the site after remediation, but remains restricted for burrowing animals. Long-term maintenance is required to ensure the integrity of the cap. The total estimated present worth cost of this alternative is $1,100,000. Table B4.17-6 details the costing for this alternative.

17.11.5 Alternative 6b/B5a/A4/U4a: Direct Thermal Desorption of Principal Threat Volume; Caps/Covers with Consolidation

Alternative 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation, along with Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation, Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4a: Detonation (Off-Post Army Facility), addresses the consolidation and

containment of 700,000 BCY of contaminated soils and the treatment of 19,000 BCY of principal threat exceedances by thermal desorption. The demolition of structures is required to allow the excavation of contaminated soils. The structural debris is removed from the site along with any abandoned utilities encountered during excavation. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed. Due to the potential odor problems, excavation is conducted so that only minimal area is uncovered and exposed at any one time, and a daily soil cover or plastic liner is installed over the excavated areas to further reduce the odor emissions.

This subgroup includes 43,000 SY of area with potential agent presence and 15,000 SY of area with potential UXO presence. Prior to excavation, the area with a potential UXO presence is cleared using geophysical screening. Any identified UXO are excavated, packaged, and transported off post for demilitarization at an existing Army facility. The 5,000 BCY of metallic debris mixed with surface soils are excavated and placed in the on-post landfill.

Prior to excavation, the soil is screened for agent using real-time field analytical methods. If agent presence is confirmed by RMA laboratory analysis, the soil is excavated and transported to the on-post rotary kiln incinerator for treatment. It is assumed that there are approximately 140 BCY of agent-contaminated soils in this subgroup. (Section 4.6 discusses the details of incineration.) Operating parameters of the incinerator include an operating temperature of 760°C, a soils residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the total soils feed (1 BCY) is recovered as particulates from the scrubber blowdown and is placed in the on-post hazardous waste landfill. The treated soils are returned to the site as backfill.

The principal threat volume is excavated and transported to the centralized thermal desorption facility. (Section 4.6 discusses the details of thermal desorption.) The soils for this subgroup are classified as dry (i.e., moisture content of 10 percent). Based on the moisture content, the thermal desorber processes the soils at a rate of approximately 2,000 BCY/day, and discharges

them at a temperature of 300°C, with a total soils residence time of 30 minutes. (Section 4.6.24 discusses emission controls for off gases from thermal desorption). Approximately 190 BCY of particulates from scrubber blowdown (1 percent of the total soils feed), is disposed in the on-post landfill. The treated soils from the thermal desorber are returned to the sites as backfill. Thermal desorption removes much of the organic content in the soils; therefore, 6 inches of topsoil obtained off post is placed over the disturbed area and revegetated with native grasses.

After treatment of principal threats, 700,000 BCY of remaining exceedance soils are excavated and transported to the Central Processing Area for consolidation under a clay/soil cap. This alternative is predicated on the selection of Alternative 6a for the South Plants Central Processing Area Subgroup. The excavated areas are backfilled with clean borrow material from the on-post borrow area to return them to original grade. The cover at the Central Processing Area provides a physical barrier to protect human and biota receptors from directly contacting exceedance soils and reduces contaminant migration to groundwater. All disturbed areas are revegetated with native grasses, which increases the habitat value at the site. The borrow area is also regraded and revegetated. No maintenance activities are required at the sites because all exceedance soils are removed, although they are required at the Central Processing Area to ensure the integrity of the clay/soil cap.

Table 17.11-5 provides an evaluation of Alternative 6b against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through thermal treatment and consolidation and containment at the Central Processing Area. The potential for migration of contaminants to groundwater is reduced and exposure pathways are interrupted. Habitat is improved at the sites and restored at the borrow area. Long-term monitoring includes maintenance of the clay/soil cap at the Central Processing Area and at the landfill where the particulates are disposed. The total estimated present worth cost of this alternative is $27,000,000. Table B4.17-6b details the costing for this alternative.

17.11.6 Alternative 13/B6/A4/U4a: Direct Thermal Desorption; Direct Solidification/Stabilization

Alternative 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification), paired with Alternative B6: Direct Thermal Desorption (Direct Heating), Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4a: Detonation (Off-Post Army Facility), treats 630,000 BCY of soils with organic exceedances by thermal desorption and 112,000 BCY of soils with inorganic exceedances by solidification. (Section 4.6 discusses the details of these technologies.) The demolition of structures is required to allow the excavation of contaminated soils. The structural debris is removed from the site along with any abandoned utilities encountered during excavation. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed. Due to the potential odor problems, excavation is conducted so that only a minimal area is uncovered and exposed at any one time, and a daily soil cover or plastic liner is installed over the excavated areas to further reduce the emissions.

This subgroup includes 43,000 SY of area with potential agent presence and 15,000 SY of area with potential UXO presence. Prior to excavation, the area with UXO presence is cleared using geophysical screening. Any identified UXO are excavated, packaged, and transported off-post for demilitarization at an existing Army facility. There are 5,000 BCY of metallic debris mixed with surface soils that are excavated and placed in the on-post landfill.

Prior to excavation, the soils are screened for agent using real-time field analytical methods. If agent is confirmed by RMA laboratory analysis, the soils are excavated and transported to the on-post rotary kiln incinerator for treatment. It is assumed that there are approximately 140 BCY of agent-contaminated soils in this subgroup. (Section 4.6 discusses the details of incineration.) Operating parameters of the incinerator include an operating temperature of 760°C, a total soils residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.24 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the total

soils feed (1 BCY) is recovered as particulates from the scrubber blowdown and is placed in the on-post hazardous waste landfill. The treated soils are returned to the site as backfill.

Exceedance soils that do not contain agent are transported to the thermal desorber for treatment. The thermal desorber takes 1 year to build and requires an additional year for testing. The soil for this subgroup is classified as dry (i.e., moisture content of 10 percent). Based on the moisture content, the thermal desorber processes the soil at a rate of approximately 2,000 BCY/day, and discharges them at a temperature of 300°C, with a total soils residence time of 30 minutes. (Section 4.6.24 discusses emission controls for off gases from thermal desorption.) Approximately 6,300 BCY of particulates from scrubber blowdown (1 percent of the soils feed), is disposed in the on-post landfill. The treated soils that do not exceed Human Health SEC for inorganics are returned to the site excavations as backfill. Soils with residual inorganic exceedances are transported to the solidification facility for further treatment.

The 112,000 BCY of soils with inorganic exceedances are solidified near the thermal desorber using a portable pug mill capable of treating 46 BCY/day. The contaminated soils are solidified by adding cement as a binder at a 20-percent weight ratio. During excavation and solidification, the volume of contaminated soils increases by 20 percent, which results in a total solidified volume of 130,000 BCY. The solidified soils are placed in the site excavations and covered with a minimum of 4 ft of soils treated by thermal desorption to ensure the integrity of the solidified materials and prevent freeze/thaw degradation. Since thermal desorption destroys the natural organic content in the soils, 6 inches of topsoil obtained off-post is placed over the disturbed area and revegetated with native grasses to improve the habitat.

Table 17.11-6 evaluates the alternative against the EPA criteria for the DAA. This alternative achieves RAOs since all contaminated soils are treated to remove or destroy the chemical agent and UXO exceedances. Following revegetation, the impacts on groundwater quality are reduced through the treatment of contaminated soils and the habitat is improved at the site. Thermal desorption of 630,000 BCY and solidification of 112,000 BCY of soil requires approximately 12

years, including 2 years for the construction and testing of the facilities. The total estimated present worth cost of this alternative is $89,000,000. Table B4.17-13 details the costing for this alternative.

17.11.7 Alternative 19/B11a/A4/U4a: In Situ Thermal Treatment; In Situ Solidification/Stabilization

Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification), combined with Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating), Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4a: Detonation (Off-Post Army Facility), treats 720,000 BCY of human health and biota exceedances. Structures located within the subgroup area require demolition and subsequent removal of debris prior to treatment, which limits alternatives currently being evaluated for structures in this area.

This subgroup includes 43,000 SY of area with potential agent presence and 15,000 SY of area with potential UXO presence. Prior to in situ treatment, the area with potential UXO presence is cleared using geophysical screening. Any identified UXO are excavated, packaged, and transported off post for demilitarization at an existing Army facility. There are 5,000 BCY of metallic debris mixed with surface soils that are excavated and placed in the on-post landfill.

The areas with potential agent presence are screened prior to in situ treatment by screening soil cores from exploratory drillings. If agent is confirmed by RMA laboratory analysis, the soil is excavated and transported to the on-post rotary kiln incinerator for treatment. (Section 4.6 discusses the details of rotary kiln incineration.) It is assumed that there are approximately 140 BCY of agent-contaminated soils in this subgroup. Operating parameters of the incinerator include an operating temperature of 760°C, a total soils residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the total soils feed (1 BCY) is recovered as particulates in the scrubber blowdown and is placed in the on-post hazardous waste landfill. The treated soils are returned to the site as backfill.

Once the soils are screened and cleared, the 630,000 BCY of exceedance soils are treated by RF heating. RF heating raises the temperature of the soil to more than 250°C, which mobilizes the organic contaminants for collection and treatment in the off-gas treatment system. (Section 4.6.29 discusses details of RF heating.) One RF unit treats contamination from 0 to 10 ft below ground surface in a block that is 100 ft long by 48 ft wide by 10 ft deep. Assuming a soils moisture content of 10 percent, the unit treats approximately 180 BCY/day. The liquid sidestream, which contains predominantly salts, is transported to the thermal desorption facility for treatment along with the scrubber effluent. RF heating only treats the organic contaminants; therefore, soil containing inorganic contaminants requires treatment by in situ cement-based solidification.

The human health inorganic soil volume of 112,000 BCY is solidified using a transportable track-mounted boring/mixing unit and a cement batch plant capable of processing 600 BCY/day. (Section 4.6 discusses the details of in situ solidification/stabilization.) Portland cement is mixed with the excavated soils at a ratio of 20 percent by weight. Upon solidification, the soils swell approximately 20 percent due to incorporation of the cement. A 4 ft layer of borrow material (20,000 SY) from the northern portion of Section 30 is then recontoured over the area to ensure the integrity of the solidified soils and to guard against freeze/thaw stresses, and a 6-inch layer of topsoil (620,000 SY) obtained off post is placed over the entire exceedance area. Finally, the disturbed area is revegetated with native grasses to improve the habitat quality of the site but biota are removed. Long-term maintenance of the cover and monitoring of the solidified soils are required.

Table 17.11-7 evaluates Alternative 19 against the EPA criteria for the DAA. RF heating theoretically achieves Human Health and Biota RAOs with low residual risk since all OCPs and volatile metals are driven from the soil by this form of in situ thermal desorption. However, the pilot-scale test of the RF technology at RMA failed to confirm the temperature distribution and OCP removal required for confident treatment of soils to achieve PRGs. For this subgroup, Human Health PRGs are generally achieved by RF heating, and the residual levels of OCP

contamination are anticipated to be within the acceptable risk range for human health (10^{-6} to 10^{-4} excess cancer risk). The residual OCP levels are anticipated to be higher than the Biota PRGs. The treated areas are revegetated to improve habitat, but some biota risk remains due to the failure to achieve PRGs. The implementability of in situ RF heating is questionable since there is no commercial source for the equipment and the technique is as yet unproven at full scale. RF treatment of 630,000 BCY of contaminated soils is feasible in 11 years. The total estimated present worth cost of this alternative is $200,000,000. Table B4.17-19 details the costing for this alternative.

17.11.8 Alternative 20/B6 and B11/A4/U4a: In Situ Thermal Treatment; Direct Thermal Desorption; Direct Solidification/Stabilization

Alternative 20: In Situ Thermal Treatment (Surface Soil Heating); Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification), combined with Alternative B6 and Alternative B11: Direct Thermal Desorption (Direct Heating) and In Situ Thermal Treatment (Surface Soil Heating), Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4a: Detonation (Off-Post Army Facility), treats 480,000 SY of contaminated exceedance area by surface soil heating, 400,000 BCY of subsurface organic contamination by thermal desorption, and 112,000 BCY by solidification. (Section 4.6 discusses the details of these technologies.) The demolition of structures is required before the excavation of contaminated soils can begin. The structural debris is removed from the site along with any abandoned utilities encountered during excavation in this area. Dewatering is not required for safe excavation based on the anticipated decrease in water levels once man-made recharge sources (i.e., leaking water lines) are removed. Due to the potential odor problems, excavation is conducted so that only minimal area is exposed at any one time, and a daily soil cover or plastic liner is installed over the excavated areas.

This subgroup includes 43,000 SY of area with potential agent presence and 15,000 SY of area with potential UXO presence. Prior to in situ treatment, the area with potential UXO presence is cleared by geophysics. Any identified UXO area excavated, packaged, and transported off post

for demilitarization at an existing Army facility. The 5,000 BCY of metallic debris mixed with surface soils are excavated and placed in the on-post landfill.

The areas with potential agent presence are screened prior to in situ treatment by screening soil cores from exploratory drillings. If agent is confirmed by RMA laboratory analysis, the soil is excavated and transported to the on-post rotary kiln incinerator for treatment. (Section 4.6 discusses the details of rotary kiln incineration.) It is assumed that there are approximately 140 BCY of agent-contaminated soils in this subgroup. Operating parameters of the incinerator include an operating temperature of 760°C, a total soils residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the total soils feed (1 BCY) is recovered as particulates in the scrubber blowdown, and is placed in the on-post hazardous waste landfill. The treated soils are then returned to the site as backfill.

Once the soils are cleared and screened, the 480,000 SY of surficial soils containing organic exceedances are treated by in situ thermal treatment. Surface soil heating raises the temperature of the soils to more than 250°C, mobilizing the organic contaminants located in the near-surface soils. The mobilized contaminants are then collected and treated in the off-gas treatment system as described in Section 4.5.9. Two heating units are used for the South Plants Balance of Areas Subgroup. A surface soil heating unit treats a 50-ft-long, 50-ft-wide, 10-ft-deep block of soil and has a treatment rate of approximately 17,000 SY/year. The liquid sidestream from in situ heating, which contains predominantly salts, is transported to the thermal desorption facility for treatment along with the scrubber effluent.

Approximately 400,000 BCY of subsurface soils contaminated with organics—primarily OCPs—are excavated and treated by thermal desorption. The soils in this subgroup are classified as dry (i.e., soil moisture content of 10 percent). Based on the moisture content, the thermal desorber has a processing rate of approximately 2,000 BCY/day, a discharge temperature of 300°C, and a total soils residence time of 30 minutes. Operating under these conditions, all of

the mercury and some of the arsenic present in the contaminated soils are volatilized, so solidification of the treated soils is not required. (Section 4.6.24 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the total soils feed (4,000 BCY) is recovered as particulates from the off-gas equipment and is placed in the on-post landfill. The treated soils are returned to the site as backfill. The arsenic and mercury in most of the treated soils are reduced below the Biota SEC; however, 112,000 BCY of inorganic-contaminated soils require solidification.

The human health inorganic volume (112,000 BCY) is solidified using a transportable treatment unit comprised of a pug mill mixer and a cement batch plant capable of processing 46 BCY/day. Portland cement is mixed with excavated soils at a ratio of 20 percent by weight. During solidification, the soils swell approximately 20 percent due to the incorporation of the cement. The solidified soils are backfilled and covered by a minimum of 4 ft of thermally desorbed soils to ensure the integrity of the solidified material and prevent damage from freeze/thaw stresses. Topsoil is placed in a 6-inch layer over the treated human health and biota areas (620,000 SY) to provide a growth medium for vegetation. The treated area is then revegetated with native grasses to improve the overall habitat quality of the site.

Table 17.11-8 provides a detailed evaluation of Alternative 20 against the EPA criteria for the DAA. This alternative partially achieves both Human Health and Biota RAOs since a portion of the contaminated soils are treated to remove or destroy the exceedance COCs. Surface soil heating theoretically achieves Human Health and Biota RAOs with low-residual risk since all OCPs and some volatile metals are driven from the soils by this form of in situ thermal desorption. The treated areas are revegetated to improve habitat, but some biota risk remains due to the failure to achieve PRGs. The implementability of in situ surface soil heating is questionable since there is no commercial source for the equipment and the technique is as yet unproven at full scale. The treatment of contaminated soils within South Plants Balance of Areas Subgroup is feasible in a total of 14 years. The total estimated present worth cost of this alternative is $88,000,000. Table B4.17-20 details the costing for this alternative.

17.12 SOUTH PLANTS BALANCE OF AREA SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The South Plants Balance of area subgroup contains 720,000 BCY of exceedance soils contaminated as a result of miscellaneous operations in the South Plants study area. Human Health COCs include OCPs, HCCPD, and chromium, exceedances that account for 150,000 BCY of human health exceedance. Approximately 6 percent of OCP samples exceed the Biota SEC. In addition to OCPs, arsenic and mercury also exceed the Biota SEC. Of the eight Human Health COCs in human health exceedance volume, aldrin, dieldrin, isodrin, and chlordane have average concentrations exceeding the Biota SEC.

Principal threat criteria are exceeded for aldrin, dieldrin, and chlordane in 0.3 percent of the samples, generating a principal threat exceedance volume of 19,000 BCY. This subgroup also contains areas of potential UXO and agent presence, and sites in the subgroup are identified as the source of several groundwater contamination plumes.

The area within the subgroup has poor-quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration following remediation, so significant habitat impacts are expected although alternatives involving containment with a cap/cover require the exclusion of burrowing animals.

Excavation of soils in the South Plants Balance of Areas Subgroup requires clearing the soils of UXO, screening the soils for agent, and providing health and safety protection for site workers. In addition, only minimal area is open at any one time during excavation, and a daily soil cover or plastic liner is used to prevent odor emissions from impacting the community.

In summary, this subgroup contains human health and biota exceedances and limited areas of agent, UXO, and principal threat exceedances. Sites in the subgroup contribute to groundwater contamination. Selection of the preferred alternative should consider the longer-term risks of

contaminant migration and exposure if contaminants remain in place against the short-term risks to workers and the community if contaminated soils are excavated.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs and is eliminated from further consideration as the preferred alternative. Alternative 1a: Direct Thermal Desorption of Principal Threat Volume; No Additional Action treats the highest levels of contamination, but still does not achieve Human Health or Biota RAOs, and is also eliminated from further consideration. The remaining five alternatives achieve RAOs and meet the two DAA threshold criteria: protective of human health and environment and compliance with action-specific and location-specific ARARs in the DAA.

The in situ heating technologies involved in Alternative 19: In Situ Thermal Treatment; In Situ Solidification/Stabilization and Alternative 20: In Situ Thermal Treatment; Direct Thermal Desorption; Direct Solidification/Stabilization are unproven at full scale and the equipment is not available for full-scale operation. Alternative 19 exhibits the highest cost ($200,000,000) of the protective alternatives. The residual levels of OCPs following in situ heating for both alternatives are anticipated to be within the acceptable human health risk range of 10^{-4} to 10^{-6}, but are not anticipated to achieve Biota PRGs.

Alternative 3: Landfill exhibits a higher cost ($44,000,000) than the treatment/containment alternative (Alternative 6b: Direct Thermal Desorption of Principal Threat Volume; Caps/Covers with Consolidation) and does not treat any of the contaminants. Alternative 13: Direct Thermal Desorption; Direct Solidification/Stabilization is significantly more costly ($89,000,000) than the similar treatment option, Alternative 6b, since it treats the entire exceedance area. Both alternatives use thermal desorption to achieve RAOs to varying degrees. Alternative 6b exhibits the lowest cost ($27,000,000) of any of the protective alternatives for this subgroup. Alternative 6: Caps/Covers exhibits a higher cost ($110,000,000) than Alternative 6b since the capped area is larger and grading fill is required.

The preferred alternative for the South Plants Balance of Area Subgroup is Alternative 6b: Direct Thermal Desorption of Principal Threat Volume; Caps/Covers with Consolidation. This alternative is cost effective because it treats only the small volume of principal threats and contains the balance of the exceedance volume. In addition, consolidation of material from this subgroup within the cap for the Central Processing Area reduces long-term management and maintenance activities. The alternative is consistent with NCP guidance on the use of treatment for higher levels of contamination and on the use of engineering controls (containment) for lower levels of contamination.

The demolition of structures is required to allow the excavation of contaminated soils. The structural debris is removed from the site along with any abandoned utilities encountered during excavation. As specified in Section 6 of the Structures DAA, the debris may also be placed in the Central Processing Area prior to capping. Although the majority of the groundwater control systems evaluated in the DAA for South Plants are to be located in the South Plants Central Processing Area and South Plants Tank Farm Subgroups, and not in the South Plants Balance of Areas Subgroup, the timing of soils remediation is to be coordinated with the mass reduction and dewatering systems developed for Alternative SPC-7/SPT-2/SPT-5 in the South Plants Plume Group.

Table 17.0-1 Characteristics of the South Plants Medium Group

Characteristic	South Plants Central Processing Area Subgroup	South Plants Ditches Subgroup	South Plants Tank Farm Subgroup	South Plants Balance of Areas Subgroup
Contaminants of Concern				
Human Health	OCPs, volatiles, HCCPD, DBCP, DCPD, CLC2A, As, Hg, ICP metals	OCPs, ICP metals	DCPD (indirect)	OCPs, HCCPD, ICP metals
Biota	OCPs, As, Hg	OCPs, Hg, As[1]	OCPs	OCPs, As, Hg
Exceedance Area (SY)				
Total	220,000	93,000	94,000	620,000
Human Health	220,000	55,000	73,000	120,000
Biota	3,600	38,000	21,000	500,000
Potential Agent	87,000	0	0	43,000
Potential UXO	0	0	0	15,000
Exceedance Volume (BCY)				
Total	620,000	200,000	240,000	720,000
Human Health	440,000	60,000	210,000	150,000
Organic	400,000	60,000	210,000	62,000
Inorganic	58,000	420	0	112,000
Principal Threat	320,000	6,300	0	19,000
Biota	180,000	140,000	32,000	570,000
Potential Agent	290	0	0	140
Potential UXO	0	0	0	49

[1] Biota contaminants of concern are only present as overlap within human health exceedance areas.

Table 17.0-1 Characteristics of the South Plants Medium Group

Characteristic	South Plants Central Processing Area Subgroup	South Plants Ditches Subgroup	South Plants Tank Farm Subgroup	South Plants Balance of Areas Subgroup
Depth of Contamination (ft)				
Human Health	0–10	0–5, mostly 0–1	0–10	0–6.5
Biota	0–10	0–10	0–5	0–10, mostly 0–5

[1] Biota contaminants of concern are only present as overlap within human health exceedance areas.

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Table 17.1-1 Summary of Concentrations for the South Plants Central Processing Area Subgroup

Contaminants of Concern	Range of Concentration[1] (ppm)	Average Concentration[1] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–7,700	180	56	560	0.68
Dieldrin	BCRL–5,600	82	40	400	0.83
Endrin	BCRL–2,500	35	15	15,000	0.029
Isodrin	BCRL–250	6	3.4	3,400	–
Chlordane	BCRL–730	4.7	3.1	260	–
CLC2A	BCRL–280	4.3	74	74,000	–
p,p,DDT	BCRL–360	5.5	26	1,300	1.4
HCCPD	BCRL–6,700	50	1,300	–	–
DBCP	BCRL–5,700	45	24	2,400	–
Carbon Tetracholoride	BCRL–35	0.3	25	2,200	–
Chloroform	BCRL–32,000	270	350	49,000	–
DCPD	BCRL–2,100	13	1,200	–	–
Arsenic	BCRL–18,000	140	530	5,300	16.5
Cadmium	BCRL–730	2.6	480	66,000	–
Chromium	BCRL–280	15	40	10,000	–
Lead	BCRL–10,000	110	1,900	1,000,000	–
Mercury	BCRL–17,000	240	470	470,000	0.99
Biota Exceedance Volume					
Aldrin	BCRL–48	1.9	56	560	0.68
Dieldrin	BCRL–38	2.0	40	400	0.83
Endrin	BCRL–4.8	0.041	15	15,000	0.029
p,p,DDE	BCRL–16	0.22	130	1,300	0.20
p,p,DDT	BCRL–22	0.61	26	1,300	1.4
Arsenic	BCRL–540	27	530	5,300	16.5
Mercury	BCRL–410	1.7	470	470,000	0.99

[1]Based on modeled concentrations within exceedance volume.

Table 17.1-2 Frequency of Detections for South Plants Central Processing Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	412	299	72.6%	16	3.9%	53	12.9%	29	7.0%	15	3.6%
Benzene	231	217	93.9%	14	6.1%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	231	216	93.5%	14	6.1%	--	--	1	0.4%	0	0.0%
Chlordane	411	399	97.1%	2	0.5%	--	--	8	1.9%	2	0.5%
Chloroacetic Acid	93	92	98.9%	0	0.0%	--	--	1	1.1%	0	0.0%
Chlorobenzene	231	223	96.5%	8	3.5%	--	--	0	0.0%	0	0.0%
Chloroform	231	199	86.1%	31	13.4%	--	--	1	0.4%	0	0.0%
p,p,DDE	412	391	94.9%	0	0.0%	21	5.1%	0	0.0%	0	0.0%
p,p,DDT	412	384	93.2%	2	0.5%	20	4.9%	6	1.5%	0	0.0%
Dibromochloropropane	413	365	88.4%	26	6.3%	--	--	9	2.2%	13	3.1%
1,2-Dichloroethane	231	231	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	413	392	94.9%	20	4.8%	--	--	1	0.2%	0	0.0%
Dieldrin	412	270	65.5%	28	6.8%	78	18.9%	27	6.6%	9	2.2%
Endrin	412	394	95.6%	1	0.2%	8	1.9%	9	2.2%	0	0.0%
Hexachlorocyclopentadiene	412	387	93.9%	24	5.8%	--	--	1	0.2%	0	0.0%
Isodrin	412	349	84.7%	17	4.1%	--	--	46	11.2%	0	0.0%
Methylene Chloride	231	213	92.2%	18	7.8%	--	--	0	0.0%	0	0.0%
Tetrachloroethane	8	8	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	231	198	85.7%	33	14.3%	--	--	0	0.0%	0	0.0%
Toluene	231	209	90.5%	22	9.5%	--	--	0	0.0%	0	0.0%
Trichloroethylene	231	231	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	430	220	51.2%	138	32.1%	61	14.2%	9	2.1%	2	0.5%
Cadmium	336	278	82.7%	57	17.0%	--	--	1	0.3%	0	0.0%
Chromium	337	122	36.2%	210	62.3%	--	--	5	1.5%	0	0.0%
Lead	337	193	57.3%	142	42.1%	--	--	2	0.6%	0	0.0%
Mercury	394	232	58.9%	116	29.4%	45	11.4%	1	0.3%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 17.2-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants due to natural attenuation; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Central Processing Area Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) High residual risk. OCPs, volatiles, CLC2A, DBCP, HCCPD, arsenic, mercury, and ICP metals above Human Health SEC and OCPs, arsenic, and mercury above Biota SEC remain in soil and may impact human health and biota; potential presence of agent remains.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility, except by natural attenuation; 620,000 BCY of untreated soils remain; no reduction in hazards for agent presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alterative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction; soils with potential agent remain onsite.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $1,800,000
d) Total	d) $1,800,000

Table 17.2-2 Evaluation of Alternative 1b: Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain without controls being implemented, although principal threat volume treated. Long-term reduction in toxicity of contaminants through natural attenuation in balance of areas; principal threat volume achieves RAOs through treatment/immobilization; blowdown solids placed in on-post hazardous waste landfill; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, A-17, and A-18)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; monitoring of solidified material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Central Processing Area Subgroup, treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA, but does not comply with Army regulations (AMC-R 383-131) regarding agent demilitarization in balance of area.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 320,000 BCY thermally desorbed and returned to site as backfill; 4,000 BCY solidified and backfilled; 120,000 BCY of untreated soils remain but natural attenuation ongoing; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post hazardous waste landfill; soils with potential agent presence remain.
b) Adequacy and reliability of controls	b) Adequate controls. Monitoring of solidified soils required; site reviews and groundwater monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill and immobilization of inorganics.
c) Habitat impacts	c) Habitat quality not improved for balance of site. Habitat improved for principal threat area through revegetation; existing poor-quality habitat for balance of site not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 320,000 BCY of principal threat volume thermally desorbed to degrade organics; human exposure pathways interrupted and mobility of contaminants reduced by solidification of 4,000 BCY; no reduction in contaminant volume or mobility except by natural attenuation for balance of site; 120,000 BCY of untreated soils remain; no reduction in hazards for agent.
b) Degree and quantity of TMV reduction	b) Organics reduced below detectable levels (>99.99% destruction removal efficiency); TMV of organic compounds eliminated; mercury removed below Biota SEC; quench blowdown solids from off-gas treatment equipment with inorganics and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption and solidification irreversible.
d) Type and quantity of treatment residuals	d) 3,200 BCY of blowdown solids with inorganics and salts landfilled; 4,000 BCY of solidified soils backfilled and monitored.

Table 17.2-2 Evaluation of Alternative 1b: Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA) for South Plants Central Processing Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent screening and soils excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; odor emissions controlled by limited excavation and daily soil covers; vapors associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced through treatment of principal threat volume.
d) Time until RAOs are achieved	d) 3 years. Thermal desorption of 320,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility; solidification of 4,000 BCY feasible within 1 year; natural attenuation of untreated soils ongoing; soils with potential agent remain onsite.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; solidified soils and landfill cell monitored; demolition and removal of structures required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill and solidification; thermal desorbers, landfills, and solidification well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $8,300,000
b) Operating	b) $47,000,000
c) Long-term	c) $1,600,000
d) Total	d) $57,000,000

Table 17.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-11 and A-17)	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Central Processing Area Subgroup, incinerator, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 620,000 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) Exposure pathways interrupted and mobility of contaminants reduced through containment of 620,000 BCY in on-post landfill; soils with agent identified and treated.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent clearance and soils excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation of 620,000 BCY feasible within 1 year after 2 years for construction of on-post landfill and incinerator for agent treatment.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; demolition and removal of structures required; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.

Table 17.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the South Plants Central Processing Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $12,000,000
b) Operating	b) $21,000,000
c) Long-term	c) $2,400,000
d) Total	d) $36,000,000

Table 17.2-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health and Biota SECs covered by clay/soil cap, biota barrier, and vegetative layer, preventing exposure; groundwater impacts reduced
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-5)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Medium Group not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA but does not achieve Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 620,000 BCY of untreated soils contained through installation of 230,000-SY clay/soil cap with biota barrier.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover maintenance required; high confidence in engineering controls of clay/soil cap.
c) Habitat improved	c) Habitat quality improved. Revegetation of cap with native grasses improves habitat quality. Restrictions to burrowing animals help preserve integrity of cap and to prevent exposure.
4. Reduction in TMV through treatment	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 230,000-SY clay/soil cap; soils with agent contained with clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap/cover degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent clearance and installation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to poor-quality existing habitat.
d) Time until RAOs are achieved	d) 1 year. Installation of 230,000-SY clay/soil cap feasible within 1 year; natural attenuation of untreated soils ongoing.

Table 17.2-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; demolition of structures required; structural debris can be consolidated as grading fill prior to capping; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment and specialists readily available for cap/cover construction; clay/soil caps well demonstrated at full-scale.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $16,000,000
c) Long-term	c) $5,700,000
d) Total	d) $22,000,000

Table 17.2-5 Evaluation of Alternative 6a: Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment/immobilization of principal threat volume and containment of balance of areas; organics principal threat volume treated to organics detection level; inorganics principal threat volume solidified, preventing exposure; contaminated soils for balance of areas contained by installation of clay/soil cap, preventing human and biota exposure; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, A-8, A-10, A-17, and A-18)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained and solidified material; state regulations on air emissions sources and landfill siting, design, and operation achieved; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Central Processing Area Subgroup. treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA, but does not comply with Army regulations (AMC-R 383-131) regarding agent demilitarization, except for principal threat areas.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 320,000 BCY thermally desorbed and returned to site as backfill; 4,000 BCY solidified and backfilled; human and biota exposure pathways interrupted through installation of 230,000-SY clay/soil cap; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring required for solidified soils; site review required for untreated soils; erosion control and vegetative cover maintenance required; no difficulties associated with landfill maintenance; high confidence in engineering controls of clay/soil cap and landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed area habitat improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 320,000 BCY of principal threat volume thermally desorbed to degrade OCPs, volatiles, CLC2A, HCCPD, and DBCP; 4,000 BCY of principal threat volume solidified to immobilize inorganics; human and biota exposure pathways interrupted and mobility of contaminants reduced through installation of 230,000-SY clay/soil cap; soils with agent contained with clay/soil cap.
b) Degree and quantity of TMV reduction	b) Organics reduced to below detection level (99.99% destruction removal efficiency); TMV of organics eliminated; ICP metals, mercury, and arsenic immobilized during treatment; quench blowdown solids from off-gas treatment equipment with elevated metals and salts placed in landfill.
c) Irreversibility of TMV reduction	c) TMV by thermal desorption irreversible; TMV reduction irreversible if integrity of solidified materials maintained; mobility reversible if cap/cover degrades or leaks.
d) Type and quantity of treatment residuals	d) 3,200 BCY of blowdown solids with inorganics and salts landfilled; 4,000 BCY of solidified soils backfilled and monitored.

Table 17.2-5 Evaluation of Alternative 6a: Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent screening, installation, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; odor emissions controlled by limited excavation and daily soil covers; vapor emissions not anticipated during excavation; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to existing poor-quality habitat; burrowing animals excluded from area; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 320,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility; solidification of 4,000 BCY feasible within 1 year; installation of 230,000-SY clay/soil cap feasible within 1 year; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; dewatering required; demolition and removal of structures required for excavation of principal threats; structural debris can be consolidated as grading fill prior to capping; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill and cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorber; equipment, specialists, and materials readily available for solidification, cap/cover, and landfill construction; thermal desorbers, solidification, and landfills well demonstrated at full-scale.
7. Present worth costs	
a) Capital	a) \$8,000,000
b) Operating	b) \$55,000,000
c) Long-term	c) \$6,000,000
d) Total	d) \$69,000,000

Table 17.2-6 Evaluation of Alternative 13: Direct Thermal Desorption (Direct Heading); Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to organic detection level and mercury removed below Biota SEC; exposure pathways interrupted through solidification of contaminated soils; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, A-11, A-17, and A-18)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; solidified soils monitored; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Central Processing Area Subgroup. treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 580,000 BCY of organic exceedance volume thermally desorbed and returned to site as backfill; 58,000 BCY of inorganic exceedance volume solidified and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Monitoring of solidified soils required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 580,000 BCY thermally desorbed to degrade OCPs, HCCPD, volatiles, DBCP, DCPD, and CLC2A and remove mercury; exposure pathways interrupted and mobility of contaminants reduced by solidification of 58,000 BCY of soil with inorganic contaminants; soils with agent identified and treated.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Human Health and Biota SEC; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pretreatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with mercury, arsenic, ICP metals and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible; mobility reduction irreversible if integrity of solidified soils maintained.
d) Type and quantity of treatment residuals	d) 5,800 BCY of blowdown solids with mercury, arsenic, ICP metals, and salts landfilled; 58,000 BCY of solidified soils backfilled and monitored.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent clearance, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 7 years. Excavation and treatment of 580,000 BCY feasible within 2 years after 2 years for construction thermal desorption facility, incinerator for agent treatment, and landfill; solidification of 58,000 BCY feasible within 5 years.

Table 17.2-6 Evaluation of Alternative 13: Direct Thermal Desorption (Direct Heading); Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitored; solidified soils monitored to ensure integrity; demolition and removal of structures required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill and solidification; thermal desorbers, landfills, and solidification well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $15,000,000
b) Operating	b) $88,000,000
c) Long-term	c) $170,000
d) Total	d) $100,000,000

Table 17.2-7 Evaluation of Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating) In Situ Solidification/Stabilization (Cement-Based Solidification); Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative A4: Incineration/ Pyrolysis (Rotary Kiln) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment, but concentrations not reduced to achieve PRGs for point of departure; exposure pathways interrupted through solidification of contaminated soils; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-11, A-13, A-17, and A-19)	a) Complies with action-specific ARARs including state regulations on air emissions sources; solidified soils monitored; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Central Processing Area Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA and Army regulations (AMC-C 385-131) regarding agent demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 580,000 BCY thermally treated but PRGs not achieved; reduction in OCP levels within acceptable levels for human health (10^{-4} to 10^{-6} excess cancer risk); 58,000 BCY solidified in place.
b) Adequacy and reliability of controls	b) Controls not required. Monitoring of solidified soil required.
c) Habitat impacts	c) Habitat quality restored. Revegetation improves existing poor-quality habitat, but some biota risk remains as Biota PRGs not achieved.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 580,000 BCY thermally treated to degrade organics and remove mercury; exposure pathways interrupted and mobility of contaminants reduced by solidification of 58,000 BCY of soils with inorganic contaminants; soils with agent identified and treated.
b) Degree and quantity of TMV reduction	b) Reductions from RF heating (99% destruction removal efficiency) unable to achieve PRGs. TMV of organics reduced during RF heating but concentrations after treatment not able to achieve PRGs; OCP levels in treated soils within acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk); mercury condensed in blowdown liquid.
c) Irreversibility of TMV reduction	c) TMV reduction by RF heating irreversible; mobility reduction irreversible if integrity of solidified materials maintained.
d) Type and quantity of treatment residuals	d) Liquid blowdown sidestream with elevated salts and mercury treated at thermal desorption facility, along with effluent from scrubber; 58,000 BCY of solidified soils monitored.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent clearance and in situ treatment.
b) Protection of community during remedial action	b) Protective of community. No fugitive dust or odor emissions; vapor emissions associated with RF heating unit controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impact. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 14 years. RF heating of 580,000 BCY feasible within 14 years; solidification of 58,000 BCY feasible within 1 year after 2 years for construction of incinerator for agent treatment.

Table 17.2-7 Evaluation of Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating) In Situ Solidification/Stabilization (Cement-Based Solidification); Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative A4: Incineration/ Pyrolysis (Rotary Kiln) for the South Plants Central Processing Area Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of RF heating on soil with similar contaminants but unproven at full scale; additional remedial actions easily undertaken for treated soils that do not achieve PRGs; demolition and removal of structures required; solidified soils monitored to ensure integrity.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of thermal treatment unit siting, design, and operating regulations.
c) Availability of services and materials	c) Limited availability. Equipment custom designed for each application and not available; specialists only available through process licensor IITRI; no full-scale demonstration of RF equipment; equipment, specialists, and materials readily available from several vendors for solidification; solidification well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $13,000,000
b) Operating	b) $180,000,000
c) Long-term	c) $480,000
d) Total	d) $190,000,000

Table 17.4-1 Summary of Concentrations for the South Plants Ditches Subgroup

Contaminants of Concern	Range of Concentrations[2] (ppm)	Average Concentration[2] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	0.13–6,400	250	56	560	0.68
Dieldrin	0.35–720	46	40	400	0.83
Isodrin	BCRL–25	2.3	3.4	3,400	na
Chlordane	BCRL–9.2	0.8	3.1	260	na
Chromium	BCRL–100	15	40	10,000	na
Endrin[1]	BCRL–3.4	0.25	15	15,000	0.029
p,p,DDE[1]	BCRL–2.2	0.19	130	1,300	0.20
p,p,DDT[1]	BCRL–9.1	0.4	26	1,300	1.4
Arsenic[1]	BCRL–5.1	0.5	530	5,300	16.5
Mercury[1]	BCRL–13	0.42	470	470,000	0.99
Biota Exceedance Volume					
Aldrin	BCRL–52	3.1	56	560	0.68
Dieldrin	BCRL–23	2.9	40	400	0.83
Endrin	BCRL–0.93	0.063	15	15,000	0.029
p,p,DDE	BCRL–6.5	0.26	130	1,300	0.20
p,p,DDT	BCRL–4.8	0.19	26	1,300	1.4
Mercury	BCRL–6.6	0.31	470	470,000	0.99

1 Present above Biota SEC only, but was detected in the human health exceedance volume.

Table 17.4-2 Frequency of Detections for South Plants Ditches Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	94	43	45.7%	24	25.5%	14	14.9%	8	8.5%	5	5.3%
Benzene	20	18	90.0%	2	10.0%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	24	24	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	94	82	87.2%	9	9.6%	--	--	3	3.2%	0	0.0%
Chloroacetic Acid	15	15	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	24	24	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	24	24	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	94	68	72.3%	18	19.1%	8	8.5%	0	0.0%	0	0.0%
p,p,DDT	94	69	73.4%	22	23.4%	3	3.2%	0	0.0%	0	0.0%
Dibromochloropropane	52	52	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	24	24	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	4	4	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	56	56	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	94	33	35.1%	27	28.7%	22	23.4%	11	11.7%	1	1.1%
Endrin	94	65	69.1%	8	8.5%	21	22.3%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	83	73	88.0%	10	12.0%	--	--	0	0.0%	0	0.0%
Isodrin	94	64	68.1%	24	25.5%	--	--	6	6.4%	0	0.0%
Methylene Chloride	24	24	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	24	24	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Toluene	20	20	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	24	24	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	36	27	75.0%	9	25.0%	0	0.0%	0	0.0%	0	0.0%
Cadmium	53	52	98.1%	1	1.9%	--	--	0	0.0%	0	0.0%
Chromium	53	11	20.8%	41	77.4%	--	--	1	1.9%	0	0.0%
Lead	53	31	58.5%	22	41.5%	--	--	0	0.0%	0	0.0%
Mercury	68	40	58.8%	27	39.7%	1	1.5%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.
BCRL Below Certified Reporting Limit
HH SEC Human Health Site Evaluation Criteria
ppm parts per million
SEC Site Evaluation Criteria

Table 17.5-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants due to natural attenuation; surface-water impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Ditches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. OCPs and ICP metals above Human Health SEC and OCPs and mercury above Biota SEC remain in soil and may impact human health and biota.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and surface water monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume or mobility except by natural attenuation; 200,000 BCY of untreated soils remain.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to surface water not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $1,100,000
d) Total	d) $1,100,000

Table 17.5-2 Evaluation of Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented, although principal threat volume treated. Long-term reduction in toxicity of contaminants through natural attenuation for balance of areas; principal threat volume treated to OCP detection levels and inorganics removed below Biota SEC; blowdown solids placed in on-post landfill; surface-water impacts not reduced except for principal threat volume.
2. Compliance with ARARs	
a) Action-specific ARARs (See Technology Description Document, Appendix A, Tables A-1, A-8, and A-10)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Ditches Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. OCPs above Biota SEC remain in soils; 6,300 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) No controls implemented for balance of site, but adequate controls for particulates; site reviews and surface-water monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality not improved for balance of site; habitat restored for principal threat area through revegetation; existing poor-quality habitat for balance of site not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 6,300 BCY of principal threat volume thermally desorbed to degrade OCPs and remove mercury; no reduction in contaminant volume or mobility except by natural attenuation for balance of site; 190,000 BCY of untreated soils remain.
b) Degree and quantity of TMV reduction	b) OCPs reduced below detectable levels (>99.99% destruction removal efficiency); TMV of OCPs eliminated; mercury removed below Biota SEC; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pretreatment and limited volatilization during thermal desorption (20 to 30%); scrubber-blowdown solids from off-gas treatment equipment with mercury, ICP metals, arsenic, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 63 BCY of blowdown solids with mercury, ICP metals, arsenic, and salts landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation, and treatment of principal threat volume.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated from excavation; vapor emission associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to surface water reduced for principal threat area.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 6,300 BCY feasible within 1 year after 2 years for construction of thermal desorption facility; natural attenuation of untreated soils ongoing.

Table 17.5-2 Evaluation of Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; additional remedial actions easily undertaken for soils left in place.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for landfill construction; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) \$160,000
b) Operating	b) \$680,000
c) Long-term	c) \$980,000
d) Total	d) \$1,800,000

Table 17.5-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; surface-water impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (See Technology Description Document, Appendix A, Tables A-2 and A-8)	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Ditches Subgroup and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 200,000 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site, but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 200,000 BCY in on-post landfill.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to surface water reduced.
d) Time until RAOs are achieved	d) 2 years. Excavation of 200,000 BCY feasible within 1 year after 1 year for construction of on-post landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.

Table 17.5-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) \$4,000,000
b) Operating	b) \$6,500,000
c) Long-term	c) \$810,000
d) Total	d) \$0

Table 17.5-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained by clay/soil cap, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-5)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Ditches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 200,000 BCY of untreated soils contained through installation of 93,000-SY clay/soil cap with biota barrier.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover maintenance required; high confidence in engineering controls of clay/soil cap.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) Exposure pathways interrupted and mobility of contaminants reduced through installation of 93,000-SY clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of clay/soil cap.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to existing poor-quality habitat; burrowing animals excluded from area.
d) Time until RAOs are achieved	d) 1 year. Installation of 93,000-SY clay/soil cap feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; structural debrtis from remainder of South Plants can be consolidated as grading fill prior to capping; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for clay/soil cap construction; clay/soil caps well demonstrated at full scales.

Table 17.5-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $7,500,000
c) Long-term	c) $2,500,000
d) Total	d) $10,000,000

Table 17.5-5 Evaluation of Alternative 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment of principal threat volume and containment of balance of area; principal threat volume treated to below OCP detection levels and mercury reduced below Biota SEC; blowdown solids placed in on-post landfill; contaminated soils for balance of site excavated and consolidated in South Plants Central Processing Area for containment by clay/soil cap; surface-water impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (See Technology Description Document, Appendix A, Tables A-1, A-5, A-8, and A-10)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; state regulations on air emissions sources and landfill siting, designs, and operation achieved; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Ditches Subgroup, South Plants Central Processing Area, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 190,000 BCY of soils consolidated and contained in South Plants Central Processing Area with clay/soil cap; 6,300 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover require maintenance for South Plants Central Processing Area; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with clay/soil cap in South Plants Central Processing Area and landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV through treatment	
a) Treatment process used and materials treated	a) 6,300 BCY of principal threat volume thermally desorbed to degrade OCPs and remove mercury; exposure pathways interrupted and mobility of contaminants reduced through consolidation of 190,000 BCY of contaminated soils in South Plants Central Processing Area and installation of clay/soil cap in South Plants Central Processing Area.
b) Degree and quantity of TMV reduction	b) OCPs reduced below detection levels (>99.99% destruction removal efficiency); TMV of OCPs eliminated; mercury reduced below Biota SEC; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with mercury, arsenic, ICP metals, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible; mobility reduction reversible if South Plants Central Processing Area cap degrades or leaks.
d) Type and quantity of treatment residuals	d) 63 BCY of blowdown solids with mercury, arsenic, ICP metals, and salts landfilled.

Table 17.5-5 Evaluation of Alternative 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated during excavation; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to surface water reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 6,300 BCY feasible within 1 year after 2 years for construction of thermal desorption facility; consolidation of 190,000 BCY in South Plants Central Processing Area feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; additional remedial actions would require removal of cap/cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover treatment system and landfill siting, design and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for clay/soil cap and landfill construction; clay/soil caps, thermal desorbers, and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) \$160,000
b) Operating	b) \$6,100,000
c) Long-term	c) \$200
d) Total	d) \$6,330,000

Table 17.5-6 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to OCP detection levels and inorganics reduced below Biota SEC; blowdown solids placed in on-post landfill; surface-water impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (See Technology Description Document, Appendix A, Tables A-1, A-8, and A-10)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Ditches Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 200,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 200,000 BCY thermally desorbed to degrade OCPs and remove mercury.
b) Degree and quantity of TMV reduction	b) OCPs reduced below detection levels (>99.99% destruction removal efficiency); TMV of OCPs eliminated; mercury removed below Biota SEC; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with mercury, arsenic, ICP metals, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 2,000 BCY of blowdown solids with mercury, arsenic, ICP metals, and salts landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated from excavation; vapor emissions associated with thermal desorber controlled by air emissions control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impact. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to surface water reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 200,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility and landfill.

Table 17.5-6 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the South Plants Ditches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitoring.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) \$5,200,000
b) Operating	b) \$20,000,000
c) Long-term	c) \$8,000
d) Total	d) \$25,000,000

Table 17.7-1 Summary of Concentrations for the South Plants Tank Farm Subgroup

Contaminants of Concern	Range of Concentrations[2] (ppm)	Average Concentration[2] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
DCPD[1]	BCRL–850	86	1,200	not applicable	not applicable
Biota Exceedance Volume					
Dieldrin	BCRL–4.1	0.12	40	400	0.83
Endrin	BCRL–0.042	0.042	15	15,000	0.029

1 Based on indirect exposure of DCPD above the cumulative PPLV of 14.1 ppm.

Table 17.7-2 Frequency of Detections for South Plants Tank Farm Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	143	136	95.1%	7	4.9%	0	0.0%	0	0.0%	0	0.0%
Benzene	76	68	89.5%	8	10.5%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	94	94	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	143	139	97.2%	4	2.8%	--	--	0	0.0%	0	0.0%
Chlorobenzene	94	94	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	94	94	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	143	139	97.2%	4	2.8%	0	0.0%	0	0.0%	0	0.0%
p,p,DDT	143	137	95.8%	6	4.2%	0	0.0%	0	0.0%	0	0.0%
Dibromochloropropane	130	128	98.5%	2	1.5%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	94	94	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	18	18	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene(3)	149	128	85.9%	2	1.3%	--	--	19	12.8%	0	0.0%
Dieldrin	143	119	83.2%	12	8.4%	12	8.4%	0	0.0%	0	0.0%
Endrin	143	137	95.8%	1	0.7%	5	3.5%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	134	128	95.5%	6	4.5%	--	--	0	0.0%	0	0.0%
Isodrin	143	138	96.5%	5	3.5%	--	--	0	0.0%	0	0.0%
Methylene Chloride	94	87	92.6%	7	7.4%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	94	93	98.9%	1	1.1%	--	--	0	0.0%	0	0.0%
Toluene	76	74	97.4%	2	2.6%	--	--	0	0.0%	0	0.0%
Trichloroethylene	94	94	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	79	77	97.5%	2	2.5%	0	0.0%	0	0.0%	0	0.0%
Cadmium	77	77	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chromium	77	46	59.7%	31	40.3%	--	--	0	0.0%	0	0.0%
Lead	77	50	64.9%	27	35.1%	--	--	0	0.0%	0	0.0%
Mercury	89	88	98.9%	1	1.1%	0	0.0%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.
(3) HH SEC based on cumulative indirect exposure for dicyclopentadiene.

BCRL Below Certified Reporting Limit
HH SEC Human Health Site Evaluation Criteria
ppm parts per million
SEC Site Evaluation Criteria

Table 17.8-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the South Plants Tank Farm Subgroup Page 1 of 1

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants due to natural attenuation; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Tank Farm Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. DCPD above Human Health SEC at depth and OCPs above Biota SEC may impact human health and biota.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume or mobility except by natural attenuation. 240,000 BCY of untreated soils remain.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alternatives; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) \$0
b) Operating	b) \$0
c) Long-term	c) \$1,100,000
d) Total	d) \$1,100,000

Table 17.8-2 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-8,	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation achieved; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Tank Farms Subgroup and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 240,000 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 240,000 BCY in on-post landfill.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 2 years. Excavation of 240,000 BCY feasible within 1 year after 1 year for construction of on-post landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; demolition and removal of structures required; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.

Table 17.8-2 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $4,821,000
b) Operating	b) $7,907,000
c) Long-term	c) $956,000
d) Total	d) $13,700,000

Table 17.8-3 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained by clay/soil cap, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, and A-7	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Medium Group not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 240,000 BCY of untreated soils contained through installation of 94,000-SY clay/soil cap.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover maintenance required; high confidence in engineering controls of clay/soil cap.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 94,000-SY clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of clay/soil cap.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions not anticipated during excavation.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to existing poor-quality habitat quality; burrowing animals excluded from area; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 1 year. Installation of 94,000-SY clay/soil cap feasible within 1 year; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; demolition of tanks required; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for clay/soil cap construction; clay/soil caps well demonstrated at full scale.

Table 17.8-3 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $6,300,000
c) Long-term	c) $2,500,000
d) Total	d) $8,800,000

Table 17.8-4 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to OCP and DCPD detection levels; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, and A-10	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Tank Farm Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 240,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 240,000 BCY thermally desorbed to degrade OCPs and DCPD.
b) Degree and quantity of TMV reduction	b) OCPs and DCPD reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; scrubber blowdown solids from off-gas treatment equipment with salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 2,400 BCY of blowdown solids with salts landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater eliminated.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 240,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility and landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; demolition and removal of structures required; landfill cell monitored.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.

Table 17.8-4 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $6,200,000
b) Operating	b) $24,000,000
c) Long-term	c) $9,000
d) Total	d) $30,000,000

Table 17.8-5 Evaluation of Alternative 16a: In Situ Physical/Chemical Treatment (Vacuum Extraction); Alternative B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to organic detection levels; contaminated soils above Biota SEC treated in place to reduce TMV; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-24	a) Complies with action-specific ARARs including state regulations on air emissions sources; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Tank Farm Subgroup and treatment units not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 73,000 SY treated by vacuum extraction in place; 21,000 SY landfarmed, reducing TMV of surficial soils.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 73,000 SY treated by in situ vacuum extraction to remove volatiles; 21,000 SY treated in place by landfarm/agricultural practice to reduce TMV.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) TMV reduction by vacuum extraction and agricultural practices irreversible.
d) Type and quantity of treatment residuals	d) Condensed moisture from off-gas treatment system transferred to the CERCLA Wastewater Treatment Plant; spent carbon regenerated off post.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during in situ treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions not anticipated from excavation.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 10 years. Vacuum extraction of 73,000 SY feasible within 10 years; landfarm of 21,000 SY feasible within 1 year; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative implemented within required time frame and reliably operated thereafter.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for vacuum extraction; equipment and specialists readily available for landfarm/agricultural practices; vacuum extraction and landfarm/agricultural practices well demonstrated at full scale.

Table 17.8-5 Evaluation of Alternative 16a: In Situ Physical/Chemical Treatment (Vacuum Extraction); Alternative B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $2,300,000
b) Operating	b) $5,100,000
c) Long-term	c) $670,000
d) Total	d) $8,000,000

Table 17.8-6 Evaluation of Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; but concentrations reduced to achieve PRGs for point of departure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, and A-13	a) Complies with action-specific ARARs including state regulations on air emissions sources; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Tank Farm Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 210,000 BCY thermally treated in place; PRGs achieved; biological treatment of 21,000 SY reduces TMV of surficial soils.
b) Adequacy and reliability of controls	b) Controls not required. Long-term monitoring and site reviews required.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, but some biota risk remains as Biota PRGs not achieved.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 210,000 BCY thermally treated by RF heating to degrade OCPs and DCPD; 21,000 SY treated in place by biological practices, reducing TMV of contaminants.
b) Degree and quantity of TMV reduction	b) Reduction from RF heating (97-99.9% destruction removal efficiency) achieves PRGs; TMV of organics reduced during RF treatment; OCP levels in treated soils within acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk).
c) Irreversibility of TMV reduction	c) TMV reduction by in situ RF heating and landfarming irreversible.
d) Type and quantity of treatment residuals	d) Liquid blowdown sidestream with salts treated at thermal desorption facility along with scrubber effluent.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during in situ treatment.
b) Protection of community during remedial action	b) Protective of community. No fugitive dust emissions; vapor emissions associated with RF heating controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-qualitiy habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 4 years. RF treatment of 210,000 BCY feasible within 4 years; landfarming of 21,000 SY feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of RF heating on soil with similar contaminants but unproven at full scale; additional remedial actions easily undertaken for treated soils that do not achieve PRGs; demolition and removal of tanks required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system, design and operating regulations.
c) Availability of services and materials	c) Limited availability. RF equipment custom designed for each application and not available; specialists only available through process licensor ITTRI; no full scale demonstration of RF equipment; equipment, specialists and materials readily available for landfarm/agricultural practice.

Table 17.8-6 Evaluation of Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) for the South Plants Tank Farm Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $13,000,000
b) Operating	b) $67,000,000
c) Long-term	c) $700,000
d) Total	d) $81,000,000

Table 17.10-1 Summary of Concentrations for the South Plants Balance of Areas Subgroup

Contaminants of Concern	Range of Concentrations[2] (ppm)	Average Concentration[2] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–15,000	610	56	560	0.68
Dieldrin	0.67–2,600	220	40	400	0.83
Endrin	BCRL–18	1.3	15	15,000	0.029
Isodrin	BCRL–800	60	3.4	3,400	–
Chlordane	BCRL–730	36	3.1	260	–
p,p,DDT	BCRL–28	1.5	26	1,300	1.4
HCCPD	BCRL–2,600	180	1,300	–	–
Chromium	BCRL–110	14	40	10,000	–
Lead	BCRL–1,800	120	1,900	–	–
p,p,DDE[1]	BCRL–4.2	0.12	130	1,300	0.20
Mercury[1]	BCRL–2.0	0.26	470	470,000	0.99
Biota Exceedance Volume					
Aldrin	BCRL–40	0.87	56	560	0.68
Dieldrin	BCRL–29	2.2	40	400	0.83
Endrin	BCRL–2.0	0.022	15	15,000	0.029
p,p,DDE	BCRL–2.6	0.04	130	1,300	0.20
p,p,DDT	BCRL–16	0.19	26	1,300	1.4
Arsenic	BCRL–33	1.05	530	5,300	16.5
Mercury	BCRL–6.0	0.26	470	470,000	0.99

1 Biota contaminant of concern is only present as overlap within human health exceedance area.
2 Based on modeled concentrations within exceedance volume.

Table 17.10-2 Frequency of Detections for South Plants Balance of Areas Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	656	587	89.5%	36	5.5%	28	4.3%	3	0.5%	2	0.3%
Benzene	318	313	98.4%	5	1.6%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	342	342	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	656	639	97.4%	15	2.3%	--	--	0	0.0%	2	0.3%
Chloroacetic Acid	81	81	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	342	342	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	342	342	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	656	625	95.3%	26	4.0%	5	0.8%	0	0.0%	0	0.0%
p,p,DDT	656	617	94.1%	32	4.9%	7	1.1%	0	0.0%	0	0.0%
Dibromochloropropane	547	543	99.3%	4	0.7%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	342	339	99.1%	3	0.9%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	41	41	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	562	557	99.1%	5	0.9%	--	--	0	0.0%	0	0.0%
Dieldrin	656	507	77.3%	78	11.9%	63	9.6%	6	0.9%	2	0.3%
Endrin	652	609	93.4%	14	2.1%	28	4.3%	1	0.2%	0	0.0%
Hexachlorocyclopentadiene	619	602	97.3%	16	2.6%	--	--	1	0.2%	0	0.0%
Isodrin	656	621	94.7%	30	4.6%	--	--	5	0.8%	0	0.0%
Methylene Chloride	342	304	88.9%	38	11.1%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	342	334	97.7%	8	2.3%	--	--	0	0.0%	0	0.0%
Toluene	318	314	98.7%	4	1.3%	--	--	0	0.0%	0	0.0%
Trichloroethylene	342	341	99.7%	1	0.3%	--	--	0	0.0%	0	0.0%
Arsenic	532	465	87.4%	61	11.5%	6	1.1%	0	0.0%	0	0.0%
Cadmium	483	466	96.5%	17	3.5%	--	--	0	0.0%	0	0.0%
Chromium	483	193	40.0%	287	59.4%	--	--	3	0.6%	0	0.0%
Lead	483	341	70.6%	142	29.4%	--	--	0	0.0%	0	0.0%
Mercury	584	487	83.4%	88	15.1%	9	1.5%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 17.11-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants due to natural attenuation; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. Moderate levels of OCPs, HCCPD, and ICP metals above Human Health SEC and OCPs, arsenic, and mercury above Biota SEC remain in surface soils and may impact human health and biota; potential presence of agent/UXO remains.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility except by natural attenuation; 720,000 BCY of untreated soils remain; no reduction in hazards for agent or UXO presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction; soils with potential agent and UXO remain on post.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.

Table 17.11-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $5,000,000
d) Total	d) $5,000,000

Table 17.11-2 Evaluation of Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented, although principal threat volume treated. Long-term reduction in toxicity of contaminants through natural attenuation for balance of areas; principal threat volume treated to organics detection levels and mercury removed below Biota SEC; blowdown solids placed in on-post landfill; groundwater impacts not reduced, except for principal threat volume.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-10, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. Metals above Human Health SEC and OCPs, arsenic, and mercury above Biota SEC remain in soils; 19,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill; potential presence of agent/UXO remains.
b) Adequacy and reliability of controls	b) No controls implemented for balance of site, but adequate controls for particulates; site reviews and groundwater monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality not improved for balance of site; habitat restored for principal threat area through revegetation; existing poor-quality habitat for balance of site not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 19,000 BCY of principal threat volume thermally desorbed to degrade OCPs and HCCPD and remove mercury; no reduction in contaminant volume or mobility except by natural attenuation for balance of site; 700,000 BCY of untreated soils remain; no reduction in hazards for agent or UXO presence.
b) Degree and quantity of TMV reduction	b) Organics reduced below detectable levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber-blowdown solids from off-gas treatment equipment with mercury, arsenic, ICP metals, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 190 BCY of blowdown solids with mercury, arsenic, ICP metals, and salts landfilled.

Table 17.11-2 Evaluation of Alternative 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO screening, excavation, transportation, and treatment of principal threat volume.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced for principal threat areas.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 19,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility; natural attenuation of untreated soils ongoing; soils with potential agent and UXO remain on site.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; landfill cell monitored; demolition and removal of structures required for principal threats area; additional remedial actions easily undertaken for soils left in place.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for landfill construction; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $490,000
b) Operating	b) $2,200,000
c) Long-term	c) $4,400,000
d) Total	d) $7,100,000

Table 17.11-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-10, A-11, A-16, and A-17)	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation achieved; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup, incinerator, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 720,000 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat improved	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 720,000 BCY in on-post landfill; soils with agent/UXO identified and treated.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, excavation, and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation of 720,000 BCY feasible within 1 year after 2 years for construction of landfill and incinerator for agent treatment.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; demolition and removal of structures required; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.

Table 17.11-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $14,000,000
b) Operating	b) $28,000,000
c) Long-term	c) $2,600,000
d) Total	d) $44,000,000

Table 17.11-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap); Alternative U2: Caps/Covers (Clay/Soil Cap) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained by clay/soil cap, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-10, A-11, A-16, and A-17)	a) Complies with location-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup, incinerator, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 720,000 BCY of untreated soils contained through installation of 1,300,000-SY clay/soil cap, which is larger than 620,000 SY exceedance area to allow for containment of demolished debris in place.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring amd site reviews required for untreated soils; erosion control and vegetative cover maintenance required; high confidence in engineering controls of clay/soil cap.
c) Habitat improved	c) Habitat quality improved. Revegetation of cap with native grasses improves existing poor-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 1,300,000-SY clay/soil cap; soils with agent/UXO contained with clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance and installation of clay/soil cap.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to poor quality habitat; burrowing animals excluded from area.
d) Time until RAOs are achieved	d) 2 years. Installation of 1,300,000-SY clay/soil cap feasible within 2 years; natural attenuation of untreated soils ongoing.

Table 17.11-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap); Alternative U2: Caps/Covers (Clay/Soil Cap) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; demolition of structures required; structural debris can be consolidated as grading fill prior to capping; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulation.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment amd specialists readily available for cap/cover construction; clay/soil caps well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $110,000,000
d) Total	d) $110,000,000

Table 17.11-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap); Alternative U2: Caps/Covers (Clay/Soil Cap) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; demolition of structures required; structural debris can be consolidated as grading fill prior to capping; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulation.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment amd specialists readily available for cap/cover construction; clay/soil caps well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) \$0
b) Operating	b) \$0
c) Long-term	c) \$110,000,000
d) Total	d) \$110,000,000

Table 17.11-5 Evaluation of Alternative 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment of principal threat volume and containment of balance of area; principal threat volume treated to below organic detection levels and inorganics reduced below Biota SEC; blowdown solids placed in on-post landfill; contaminated soils for balance of site excavated and consolidated in South Plants Central Processing Area for containment by clay/soil cap; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, A-8, A-9, A-10, A-11, A-16, and A-17)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; state regulations on air emissions sources and landfill siting, design and operation achieved; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup, South Plants Central Processing Area, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 700,000 BCY of soils consolidated and contained in South Plants Central Processing Area with clay/soil cap; 19,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils in South Plants Central Processing Area; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with clay/soil cap in South Plants Central Processing Area and landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat.

Table 17.11-5 Evaluation of Alternative 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 19,000 BCY of principal threat volume thermally desorbed to degrade OCPs and HCCPD and remove mercury; exposure pathways interrupted and mobility of contaminants reduced through consolidation of 700,000 BCY of contaminated soils in South Plants Central Processing Area and installation of clay/soil cap in South Plants Central Processing Area; soils with agent/UXO identified and treated.
b) Degree and quantity of TMV reduction	b) Organics reduced to below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with mercury, arsenic, ICP metals and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible; mobility reduction reversible if South Plants Central Processing Area cap degrades or leaks.
d) Type and quantity of treatment residuals	d) 190 BCY of blowdown solids with mercury, arsenic, ICP metals and salts landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions associated with thermal desorber controlled by air emissions control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants of groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 19,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility; consolidation of 700,000 BCY in South Plants Central Processing Area feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated and maintained thereafter; demolition and removal of structures required; landfill cell monitored; additional remedial actions would require removal of cap/cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction and treatment system and landfill siting, design and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for clay/soil cap installation and landfill construction; clay/soil caps, thermal desorbers, and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $580,000
b) Operating	b) $26,000,000
c) Long-term	c) $20,000
d) Total	d) $27,000,000

Table 17.11-6 Evaluation of Alternative 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment/immobilization; contaminated soils treated to organic detection levels and inorganics reduced below Biota SEC; exposure pathways interrupted through solidification of contaminated soils; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-10, A-11, A-16, A-17, and A-18)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; solidified soils monitored; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup, treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 630,000 BCY of organic exceedance volume thermally desorbed and returned to site as backfill; 112,000 BCY of inorganic exceedance volume solidified and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Monitoring of solidified soils required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 630,000 BCY thermally desorbed to degrade OCPs and HCCPD and remove mercury; exposure pathways interrupted and mobility of contaminants reduced by solidification of 112,000 BCY of soils with inorganic contaminants; soils with agent and UXO identified and treated.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids with mercury, arsenic, ICP metals, and salts from off-gas treatment equipment contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible; mobility reduction by solidification irreversible if integrity of solidified soils maintained.
d) Type and quantity of treatment residuals	d) 6,300 BCY of blowdown solids with mercury, arsenic, ICP metals, and salts landfilled.

Table 17.11-6 Evaluation of Alternative 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impact. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 630,000 BCY feasible within 1 year after 2 years for construction thermal desorption facility, incinerator for agent treatment, and landfill; solidification of 112,000 BCY feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitored; solidified soils monitored to insure integrity; demolition and removal of structures required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment units and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorber and solidification unit; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers, landfills, and solidification well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $17,000,000
b) Operating	b) $72,000,000
c) Long-term	c) $270,000
d) Total	d) $89,000,000

Table 17.11-7 Evaluation of Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification); Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment, concentrations generally reduced to achieve Human Health PRGs for point of departure, but Biota PRGs not achieved; exposure pathways interrupted through solidification of contaminated soils; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-11, A-13, A-16, A-17, and A-19)	a) Complies with action-specific ARARs including state regulations on air emissions sources; solidified soils monitored; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, and Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 630,000 BCY thermally treated but Biota PRGs not achieved; Human Health PRGs generally achieved and reduction in OCP levels within acceptable levels for human health (10^{-4} to 10^{-6} excess cancer risk residual); 112,000 BCY solidified in place.
b) Adequacy and reliability of controls	b) Controls not required. Monitoring of solidified soil required.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, but some biota risk remains as Biota PRGs not achieved.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 630,000 BCY thermally treated to degrade OCPs and remove mercury; exposure pathways interrupted and mobility of contaminants reduced by solidification of 112,000 BCY of soils with inorganic contaminants; soil with agent and UXO identified and treated.
b) Degree and quantity of TMV reduction	b) Reductions from RF heating (97-99.9% destruction removal efficiency) unable to achieve Biota PRGs. TMV of OCPs reduced during RF heating and concentrations after treatment able to achieve PRGs or are within acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk); mercury condensed in blowdown liquid.
c) Irreversibility of TMV reduction	c) TMV reduction by RF heating irreversible; mobility reduction irreversible if integrity of solidified materials maintained.
d) Type and quantity of treatment residuals	d) Liquid blowdown sidestream with elevated mercury and salts treated at thermal desorption facility along with scrubber effluent; 112,000 BCY of solidified soils monitored.

Table 17.11-7 Evaluation of Alternative 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification); Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance and in situ treatment.
b) Protection of community during remedial action	b) Protective of community. No fugitive dust emissions; vapor emission associated with RF heating unit controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 11 years. RF heating of 630,000 BCY feasible within 11 years; solidification of 112,000 BCY feasible within 1 year after 2 years for construction of incinerator for agent treatment.
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of RF heating on soil with similar contaminants but unproven at full scale; additional remedial actions easily undertaken for treated soils that do not achieve PRGs; solidified soils monitored to insure integrity; demolition and removal of structures required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system siting, design, and operating regulations.
c) Availability of services and materials	c) Limited availability. Equipment custom designed for each application and not available; specialists only available through process licensor IITRI; no full-scale demonstration of RF equipment; equipment, specialists, and materials available from several vendors for solidification; solidification well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $13,000,000
b) Operating	b) $190,000,000
c) Long-term	c) 320,000
d) Total	d) $200,000,000

Table 17.11-8 Evaluation of Alternative 20: In Situ Thermal Treatment (Surface Soil Heating); Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B6/B11: Direct Thermal Desorption (Direct Heating)/In Situ Thermal Treatment (Surface Soil Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

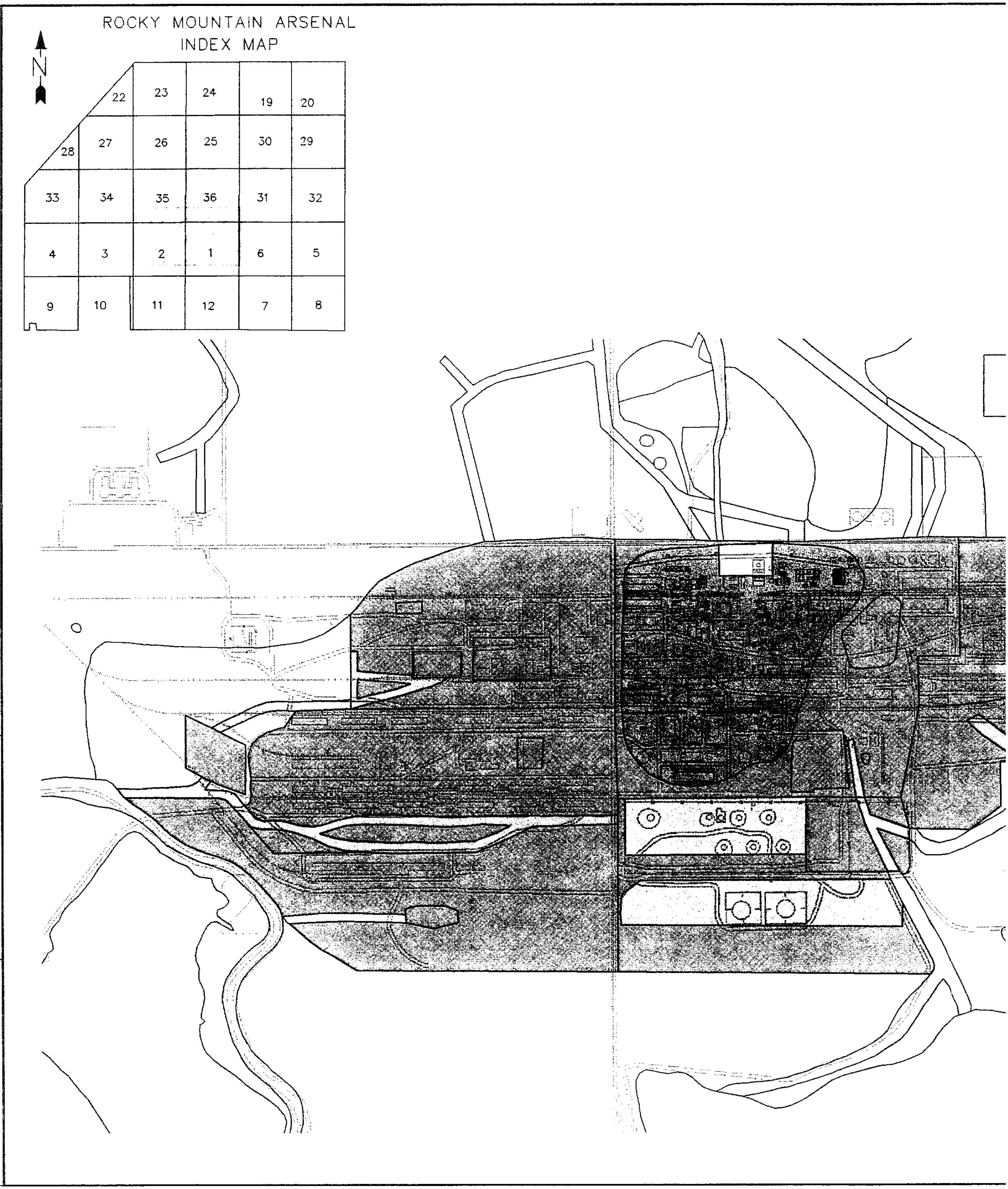
CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment for soil at depth but concentrations not reduced to achieve PRGs for point of departure for surficial soils; contaminated subsurface soils treated to organic detection levels and inorganics reduced below Human Health and Biota SEC; exposure pathways interrupted through solidification of contaminated soils; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-10, A-11, A-13, A-16, A-17, and A-19)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; solidified soils monitored; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, and Table A-2)	b) Complies with location-specific ARARs as South Plants Balance of Areas Subgroup, treatment facilities, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidance	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 480,000 SY of surface soils treated in place but PRGs not achieved; 400,000 BCY of subsurface soils excavated, thermally desorbed and returned to site as backfill; 112,000 BCY solidified and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Monitoring of solidified soils required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat but some biota risk remains as Biota PRGs not achieved.

Table 17.11-8 Evaluation of Alternative 20: In Situ Thermal Treatment (Surface Soil Heating); Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B6/B11: Direct Thermal Desorption (Direct Heating)/In Situ Thermal Treatment (Surface Soil Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 480,000 SY thermally treated by surface soil heating to degrade OCPs and HCCPD and reduce mercury; 400,000 BCY thermally desorbed to degrade OCPs and HCCPD and remove mercury; exposure pathways interrupted and mobility of contaminants reduced by solidification of 112,000 BCY of soils with inorganic contaminants; soils with agent and UXO identified and treated.
b) Degree and quantity of TMV reduction	b) Organics reduced to below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC during thermal desorption; arsenic and ICP metals reduced below Human Health and Biota SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with mercury, arsenic, ICP metals, and salts contained in on-post landfill; TMV of organics reduced during in situ thermal treatment but concentrations after treatment unable to achieve PRGs; OCP levels in treated surface soils within acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk); mercury condensed in blowdown liquid.
c) Irreversibility of TMV reduction	c) TMV reduction by in situ heating and thermal desorption irreversible; mobility reduction in solidified soils irreversible if integrity of solidified materials maintained.
d) Type and quantity of treatment residuals	d) 112,000 BCY of solidified soils backfilled and monitored; 4,000 BCY of blowdown solids with mercury, arsenic, ICP metals and salts landfilled; liquid blowdown sidestream with elevated salts and mercury treated at thermally desorption facility with scrubber effluent.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; odor and vapor emissions controlled by limited excavation and daily soil covers or plastic liners; emissions associated with surface soil heating and thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 14 years. Surface soil heating of 480,000 SY feasible within 11 years; thermal desorption of 400,000 BCY feasible within 1 year after 2 years for construction of thermal facility and incinerator for agent treatment; solidification of 112,000 BCY feasible within 10 years.

Table 17.11-8 Evaluation of Alternative 20: In Situ Thermal Treatment (Surface Soil Heating); Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B6/B11: Direct Thermal Desorption (Direct Heating)/In Situ Thermal Treatment (Surface Soil Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the South Plants Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of surface soil heating on soil with similar contaminants but unproven at full scale; demolition and of removal structures required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment units and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Limited availability. Surface soil heating equipment custom designed for each application not available; specialists only available through process licensor; no full-scale demonstration of surface soil heating equipment; several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $14,000,000
b) Operating	b) $73,000,000
c) Long-term	c) $600,000
d) Total	d) $88,000,000



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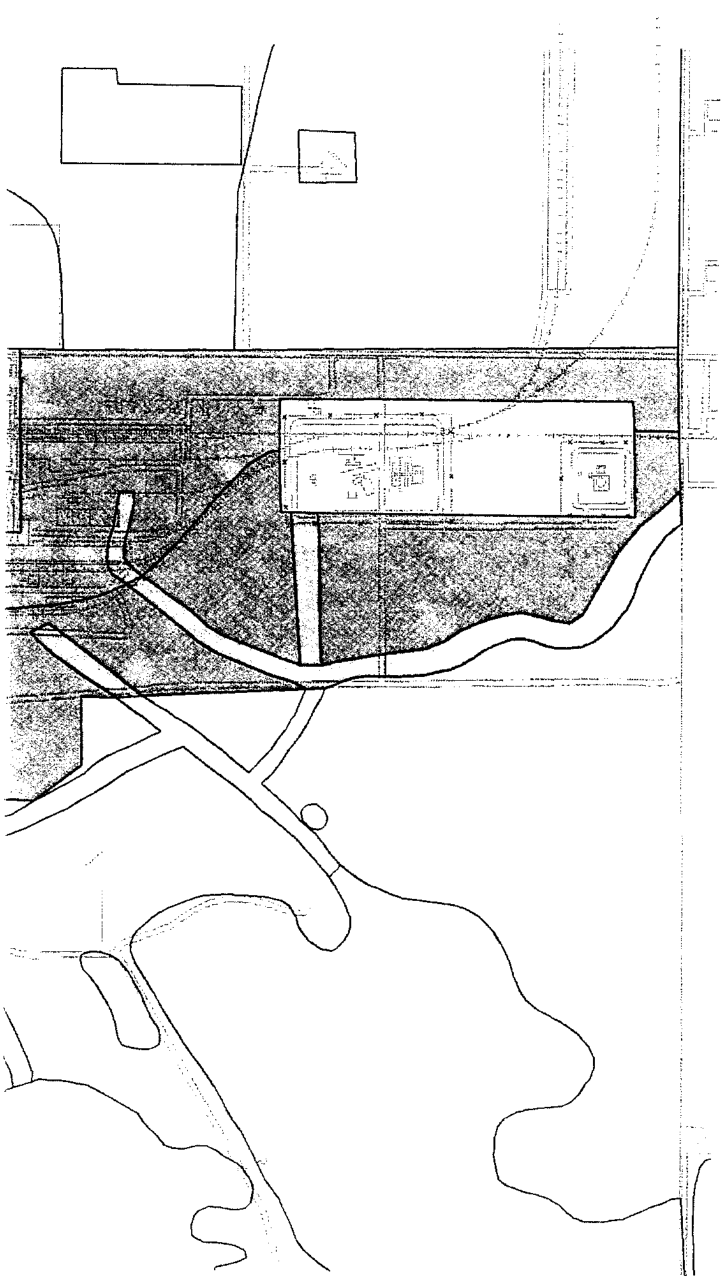

LEGEND

South Plants Central Processing Subgroup
SITE: SPSA-1a, Processing Area

South Plants Ditches Subgroup
SITES: SPSA-1d, Drainage Ditches
SPSA-2d, Drainage Ditches
SPSA-3a, Drainage Ditches
SPSA-4a, Drainage Ditches
SPSA-5a, Drainage Ditches
SPSA-8b, Drainage Ditches
SPSA-9a, Drainage Ditches

South Plants Tank Farm Subgroup
SITES: SPSA-2a, South Tank Farm
SPSA-2b, Open Storage Yard

South Plants Balance of Areas Subgroup
SITES: SPSA-1b, Mounded Material
SPSA-1c, Lime Pits
SPSA-1g, Balance of Subarea
SPSA-2c, Salvage Yard
SPSA-2e, Balance of Subarea
SPSA-3b, Salt Storage Pad
SPSA-3c, Former Tank Storage Area
SPSA-3d, Revetted Tank Storage
SPSA-3e, Balance of Subarea
SPSA-4b, Balance of Subarea
SPSA-5b, Balance of Subarea
SPSA-7b, Lagoon
SPSA-7c, Balance of Subarea
SPSA-8a, Sanitary Landfill
SPSA-9b, Balance of Subarea
SPSA-12a, Aeration Basin
SPSA-12b, Sedimentation Pond

Buried M-1 Pits Subgroup, Lime Basins Medium Group

Hex Pit Subgroup, Disposal Trenches
Medium Group

Site Boundary

Buildings and Roads

Section Number

400 0 400 800 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 17.0-1

Site Locations
South Plants Medium Group

Rocky Mountain Arsenal.
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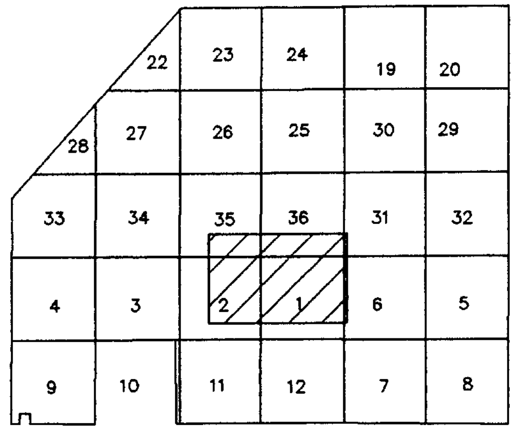
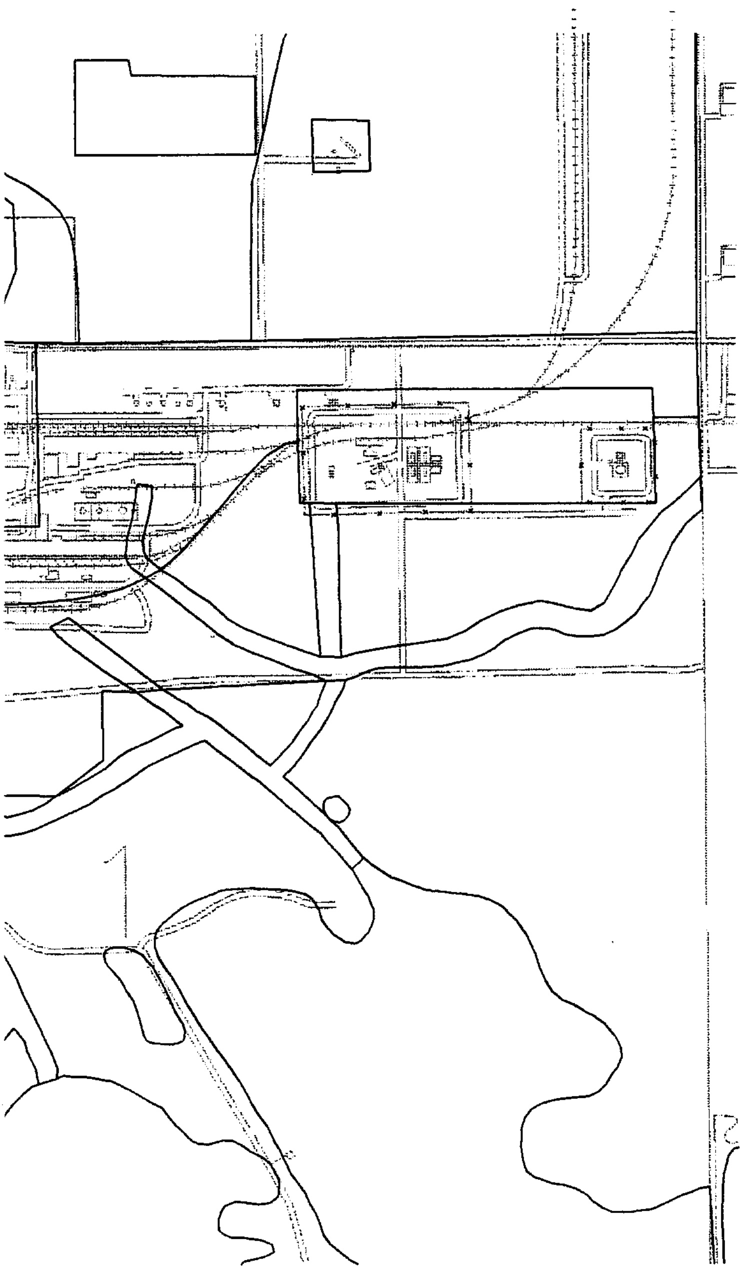
ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Biota Exceedance Area

Human Health Exceedance Area

Principal Threat Exceedance Area

Site Boundary

Buildings and Roads

Section Number

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for Rocky Mountain Arsenal

FIGURE 17.1-1

Exceedance Areas
South Plants Central Processing
Subgroup

Rocky Mountain Arsenal.
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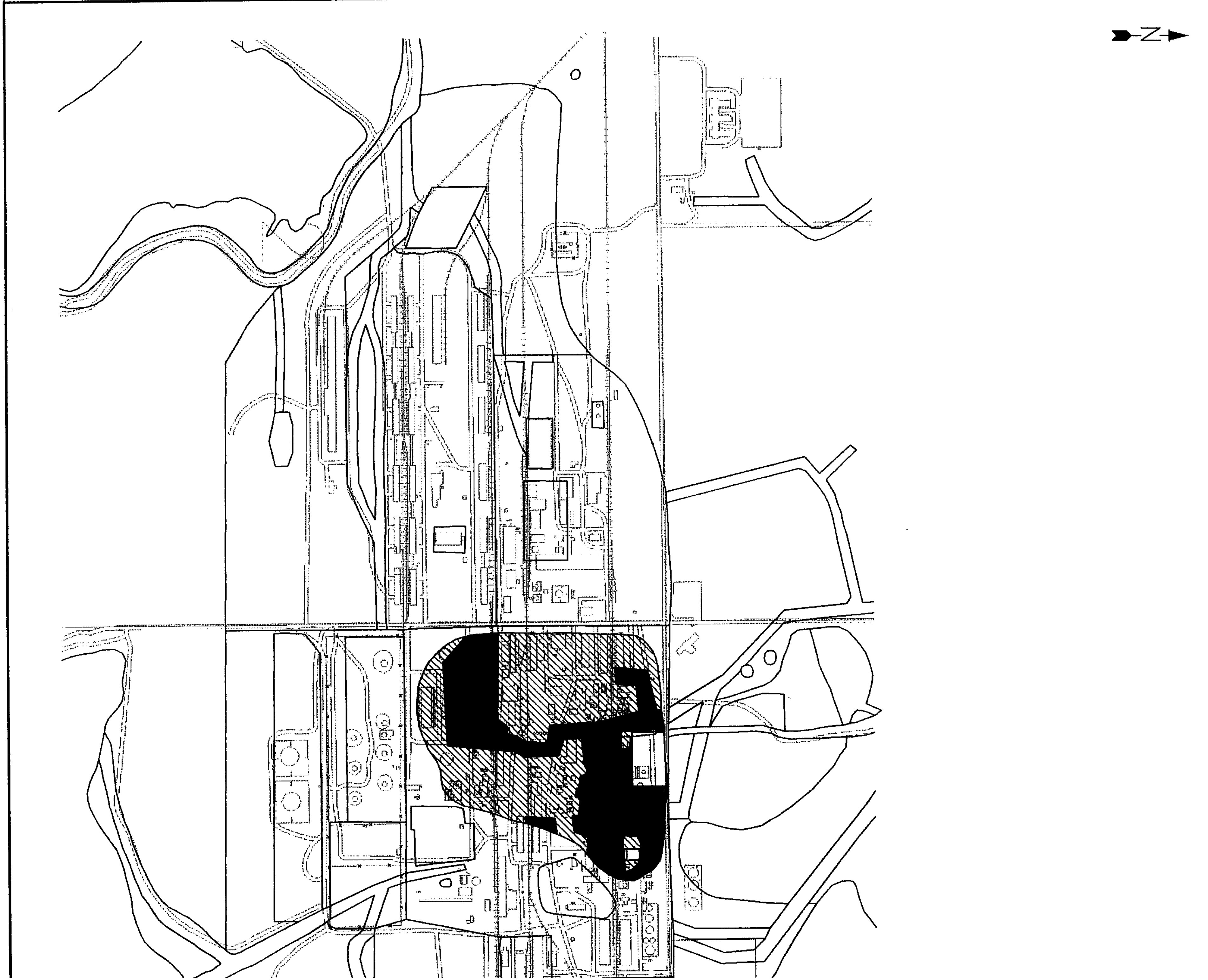
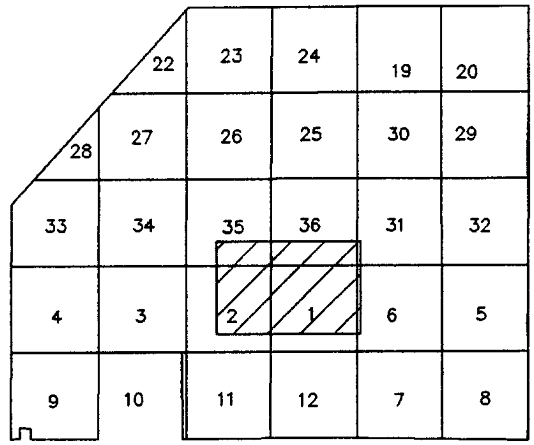
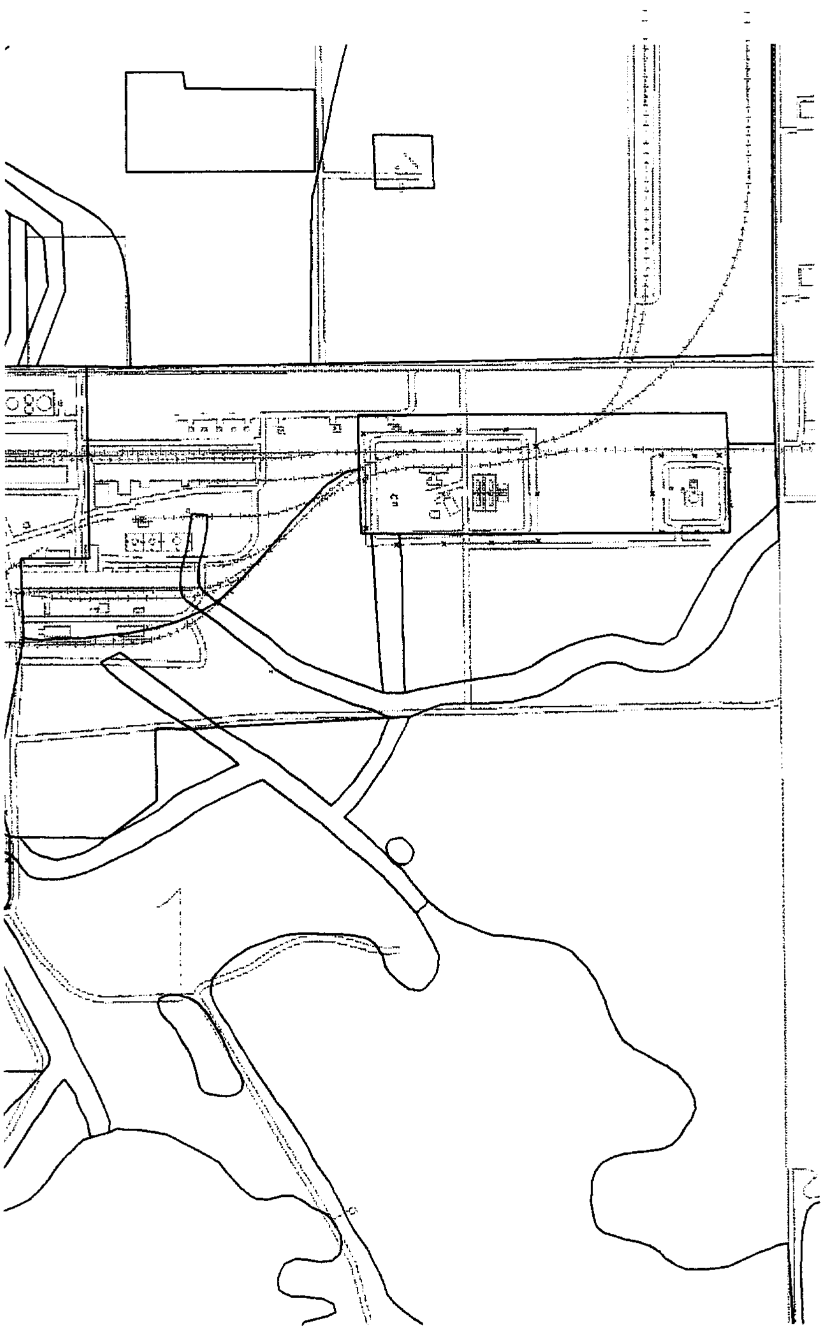


ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Human Health/Biota Exceedance Area

Potential Agent Presence Area

Site Boundary

Buildings and Roads

Section Number

400 0 400 800 FEET

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for Rocky Mountain Arsenal

FIGURE 17.1-2

Potential Agent Presence Area
South Plants Central Processing
Subgroup

Rocky Mountain Arsenal.
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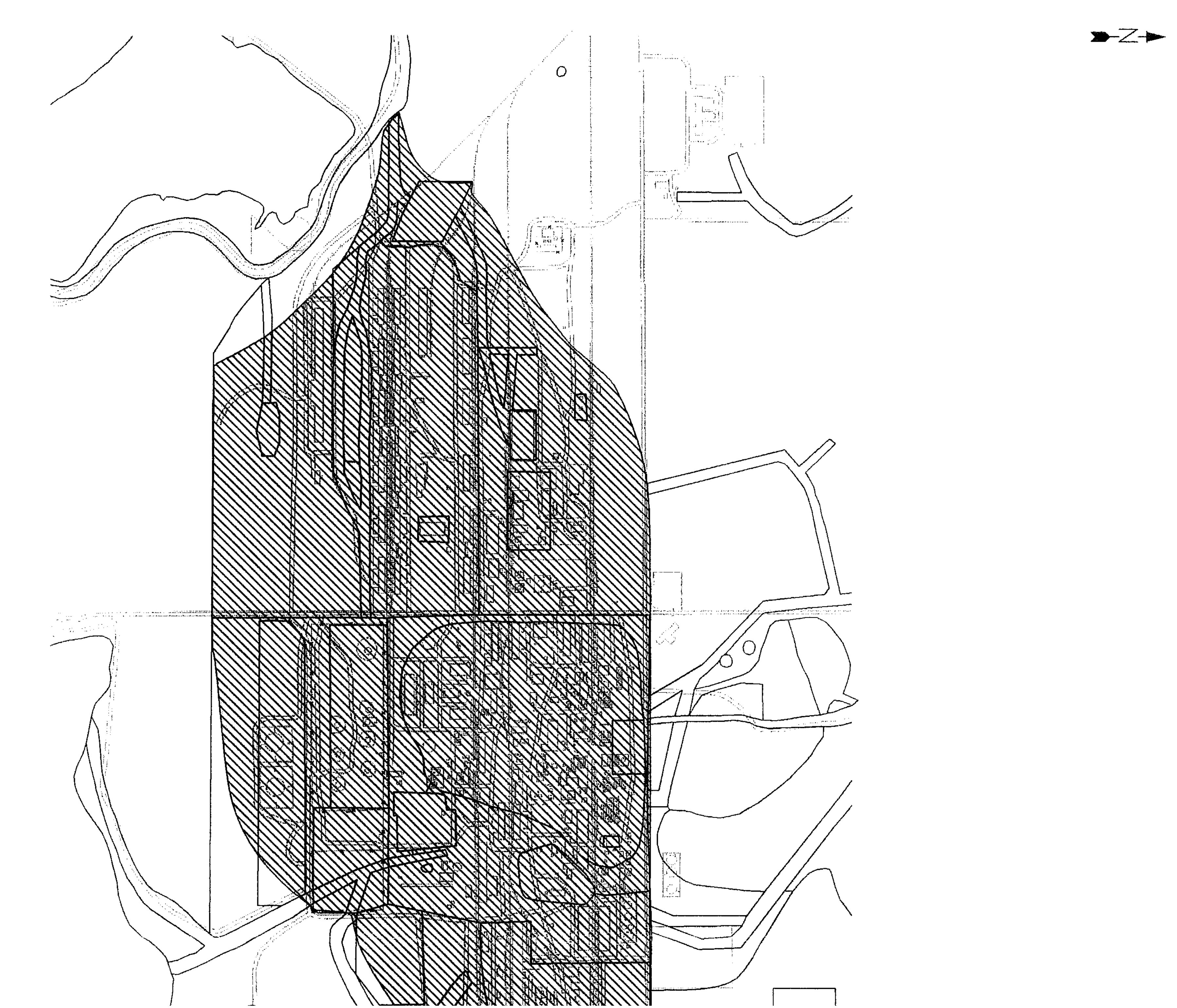
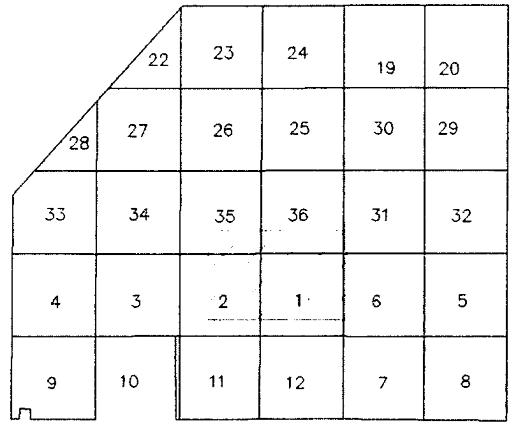
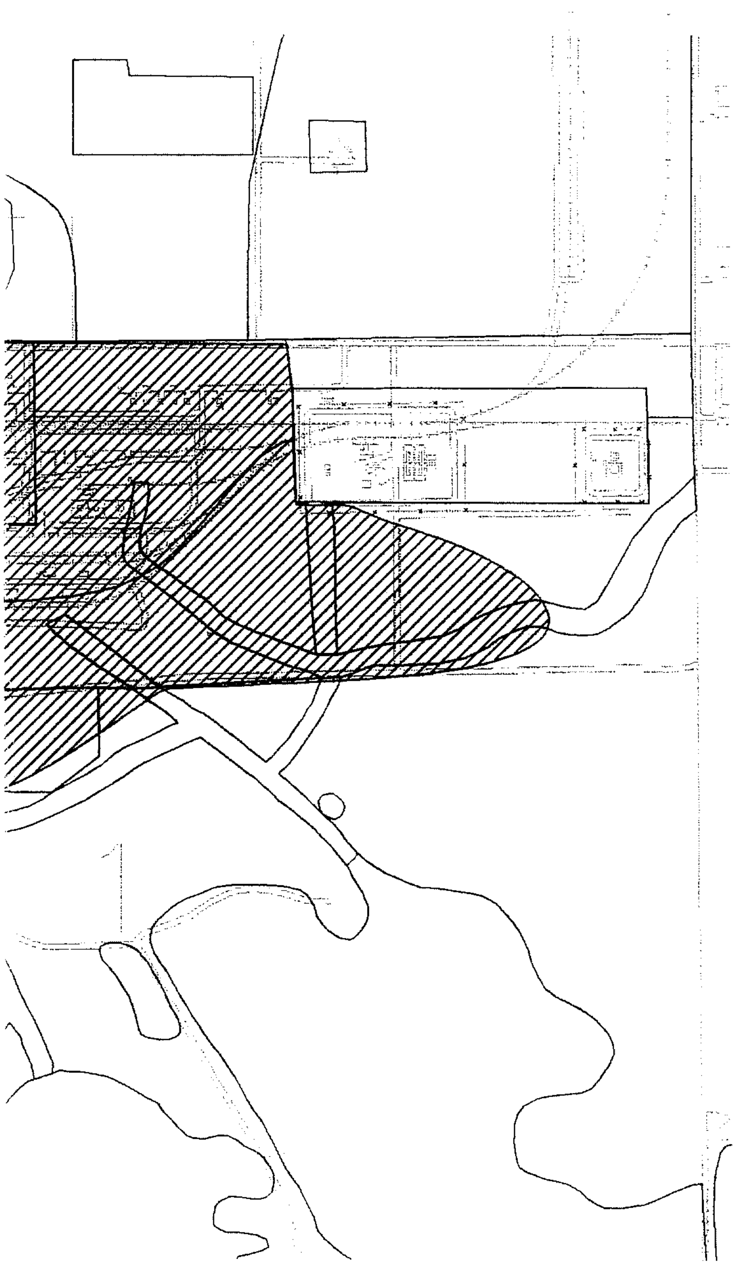


ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

South Plants Medium Group Clay/Soil Cap

Site Boundary

Buildings and Roads

Section Number

400 0 400 800 FEET

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for Rocky Mountain Arsenal

FIGURE 17.2-1

Clay/Soil Cap for South Plants Medium Group

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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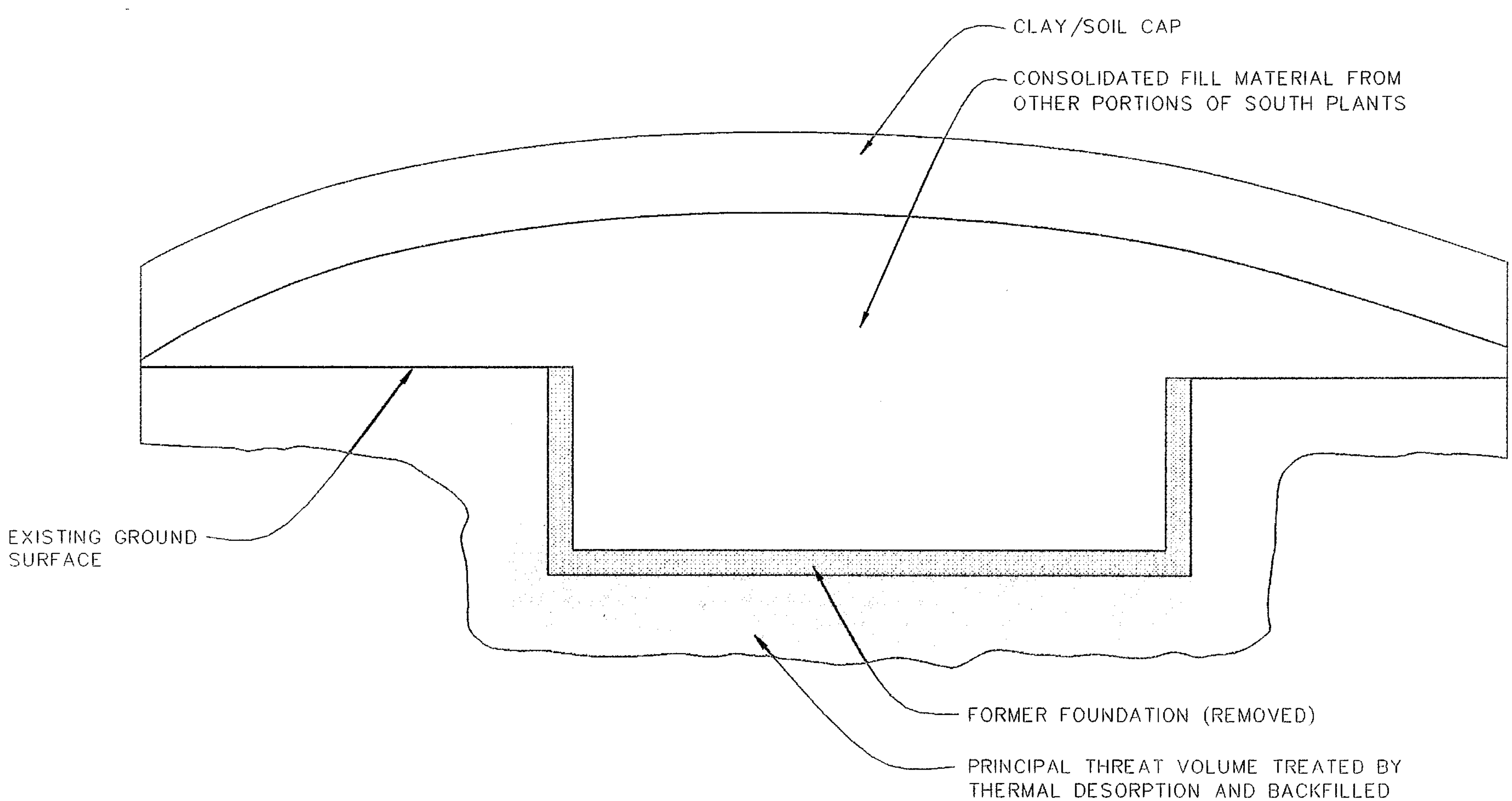

Perpared for: U.S. Army Program Manager for Rocky Mountain Arsenal

FIGURE 17.2-2
Schematic of Alternative 6a for South Plants Central Processing Subgroup

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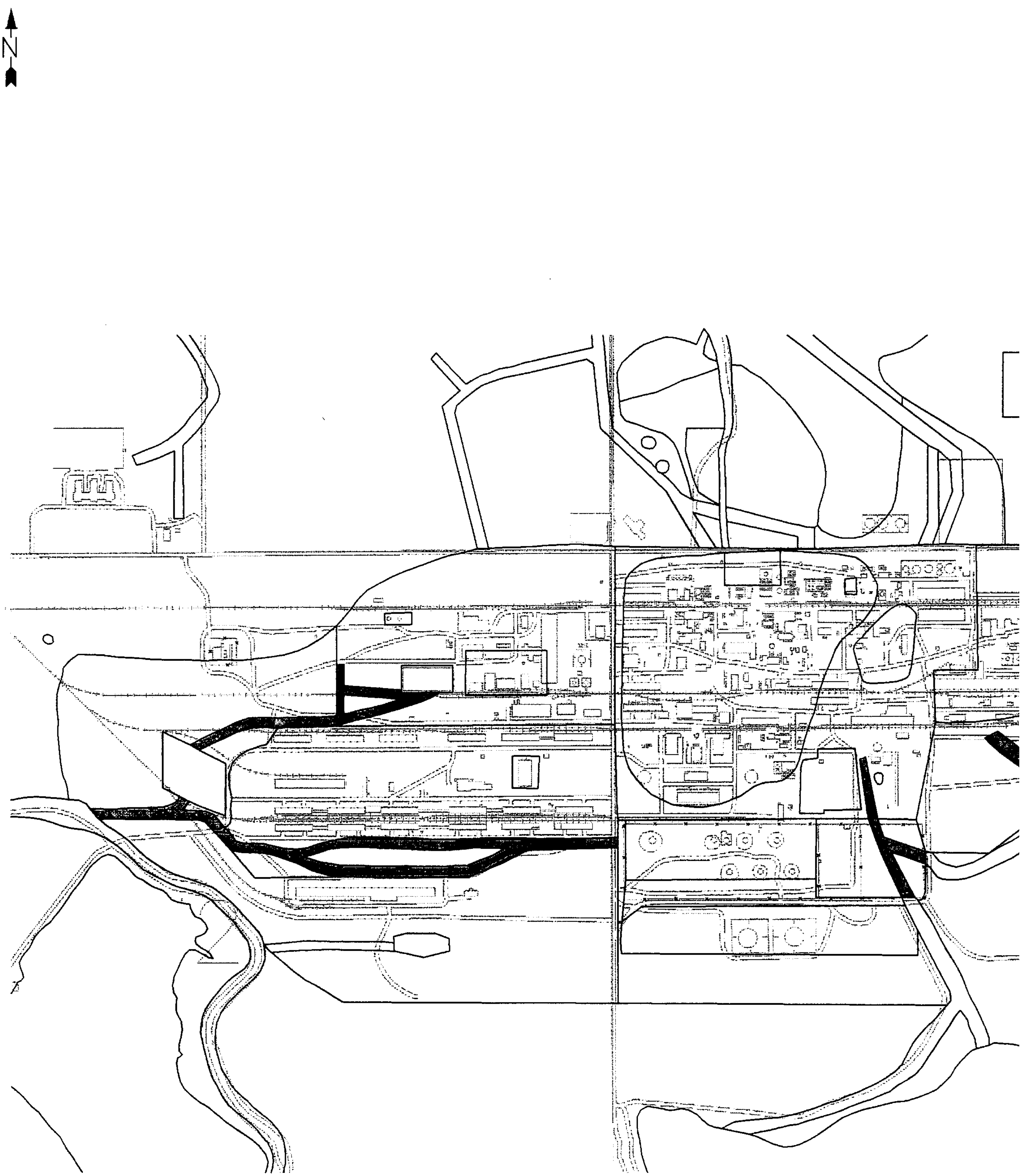

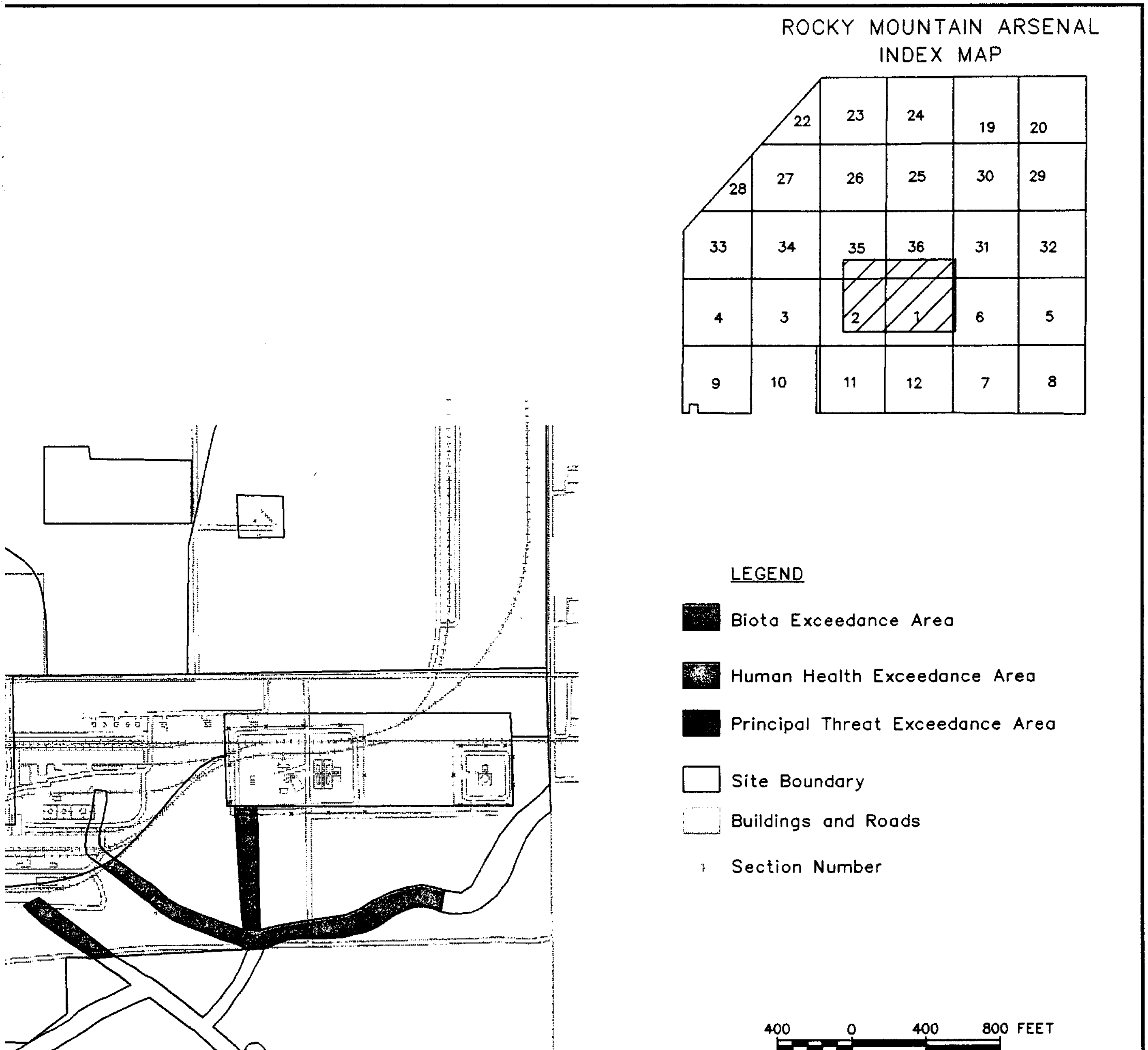

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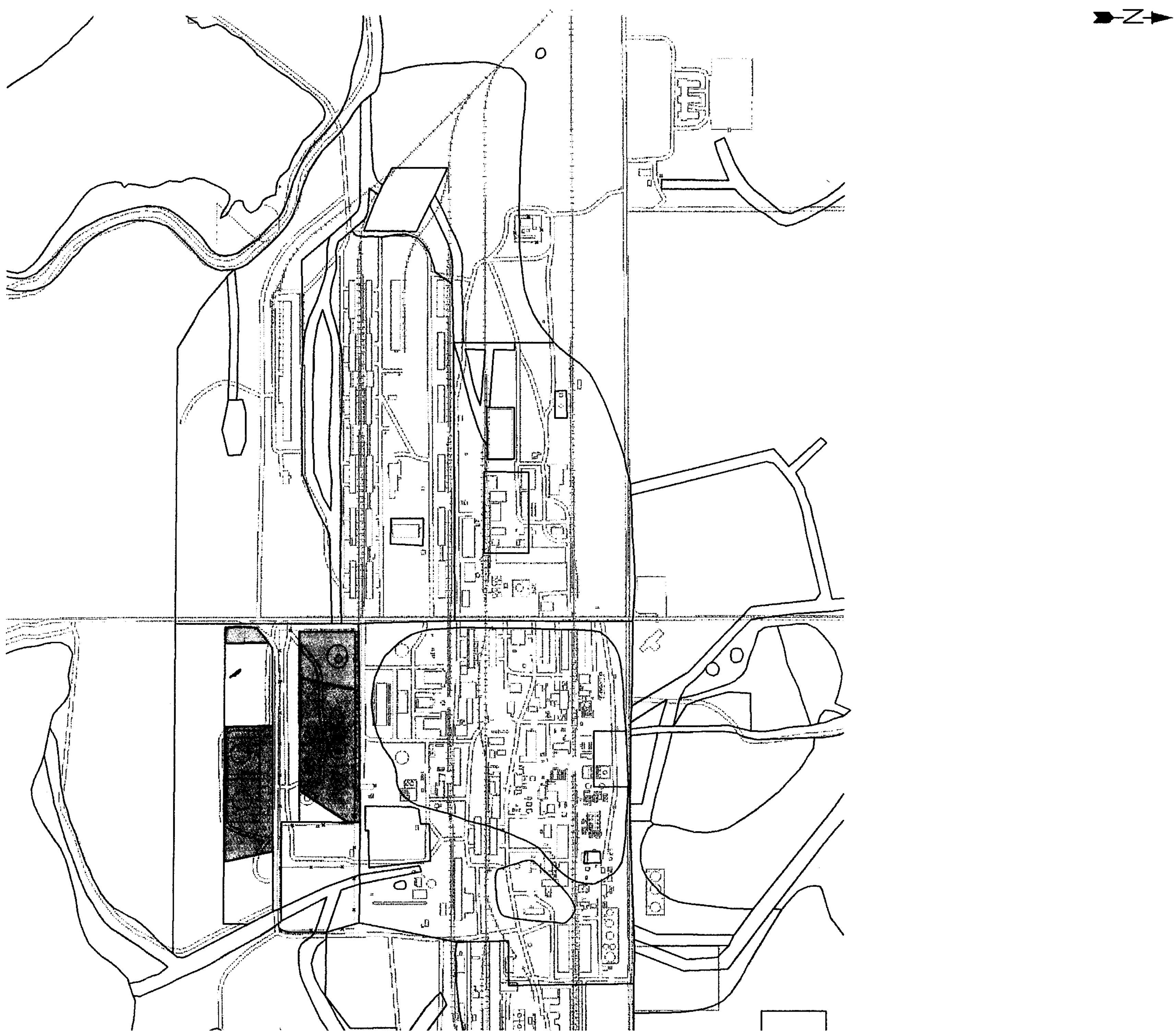
U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 17.4-1

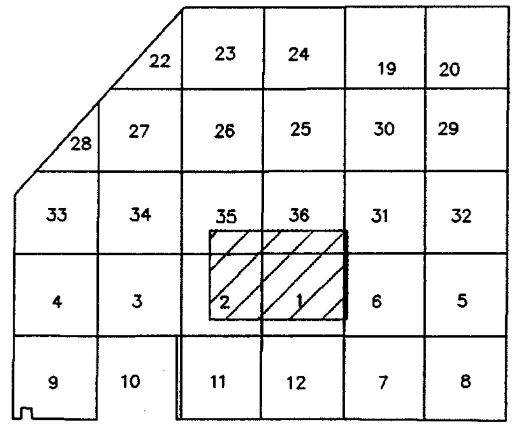
Exceedance Areas
South Plants Ditches Subgroup

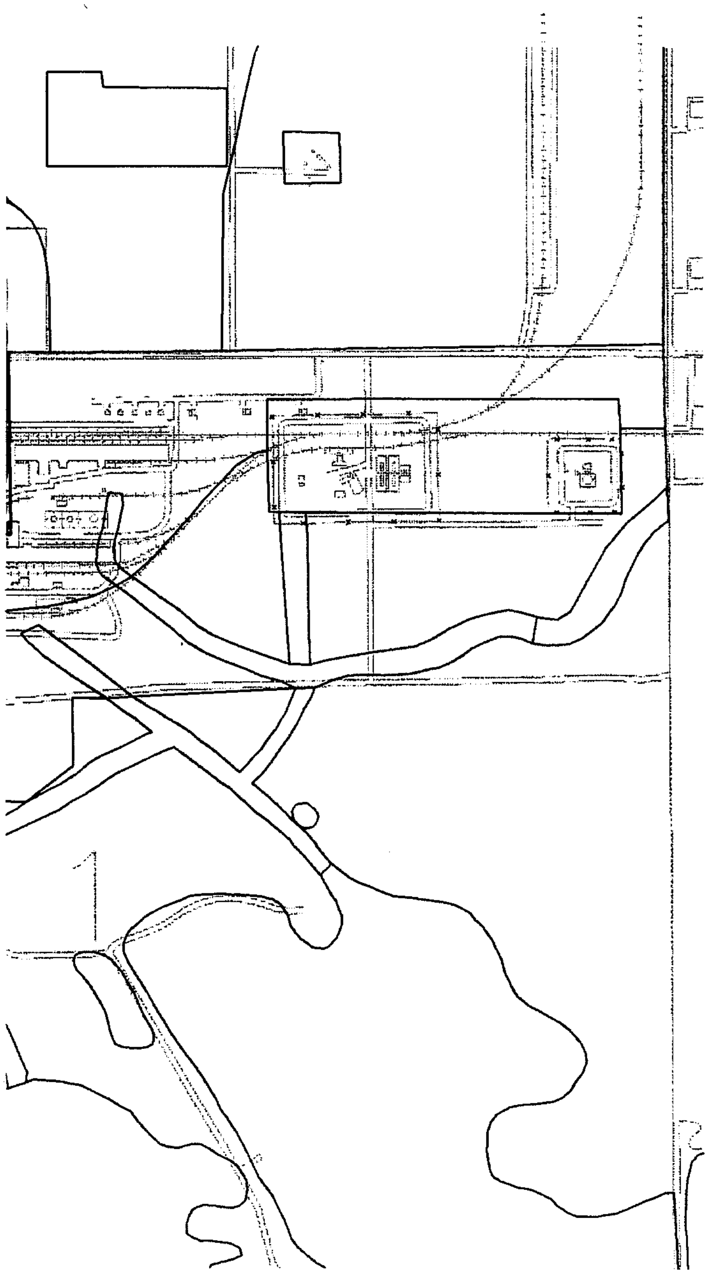
Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

CHECKED BY	APPROVED BY	DRAWN BY EMH	DATE 3/2/93	FILE NAME 20110\32\F04-021.DWG	REVISION NO. 0



ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Biota Exceedance Area

Human Health Exceedance Area
Based on Indirect PPLV Exceedance
of DCPD

Site Boundary

Buildings and Roads

Section Number

400 0 400 800 FEET

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U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 17.7-1

Exceedance Areas
South Plants Tank Farm Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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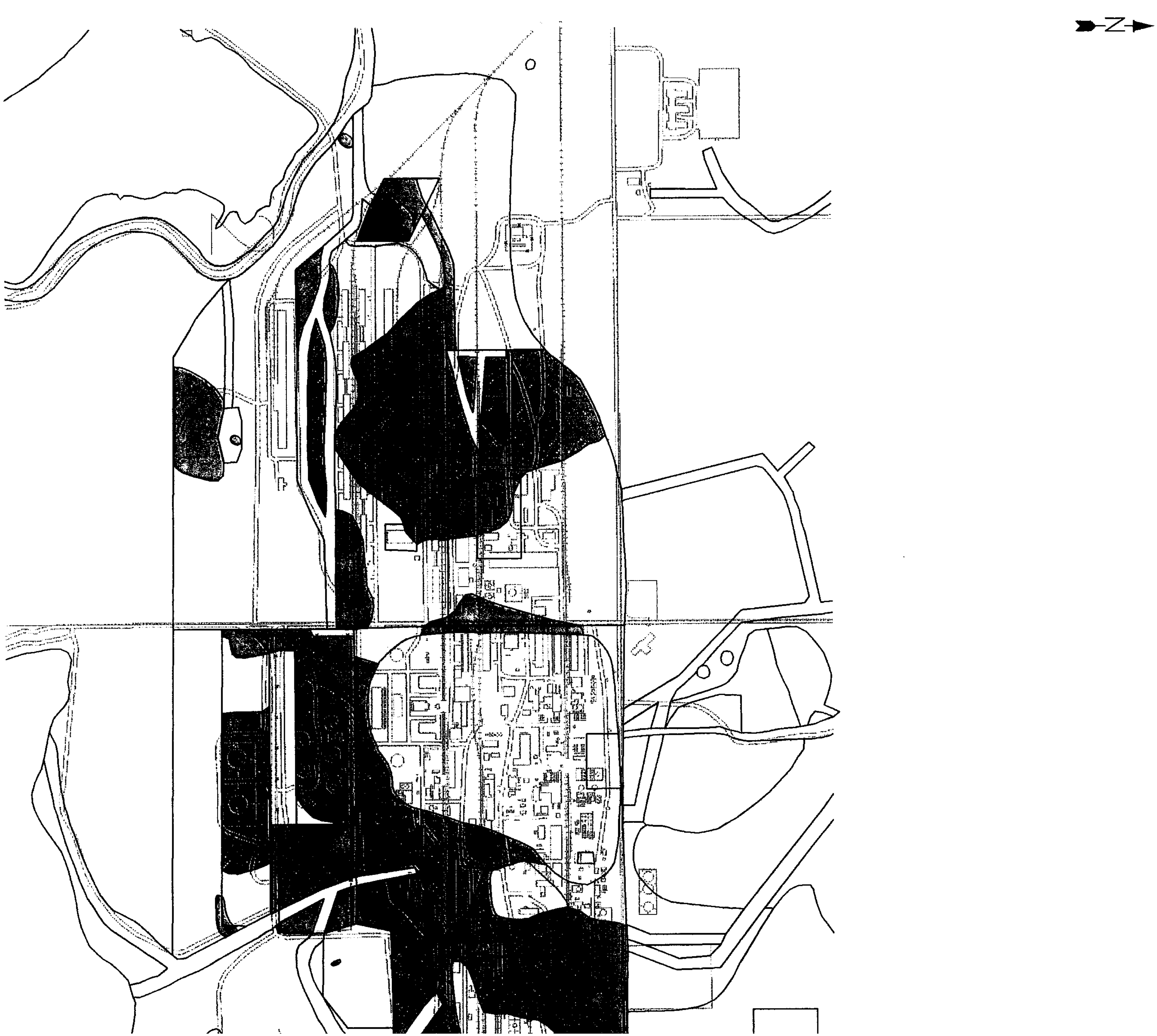
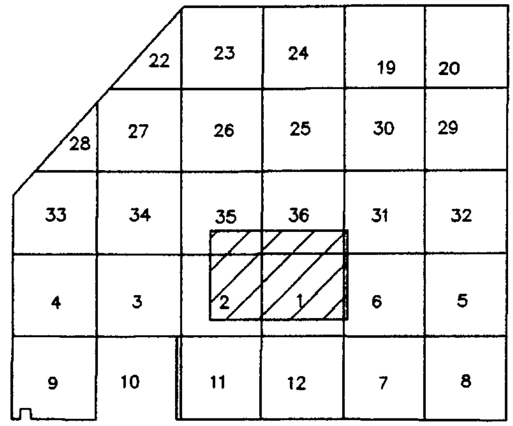
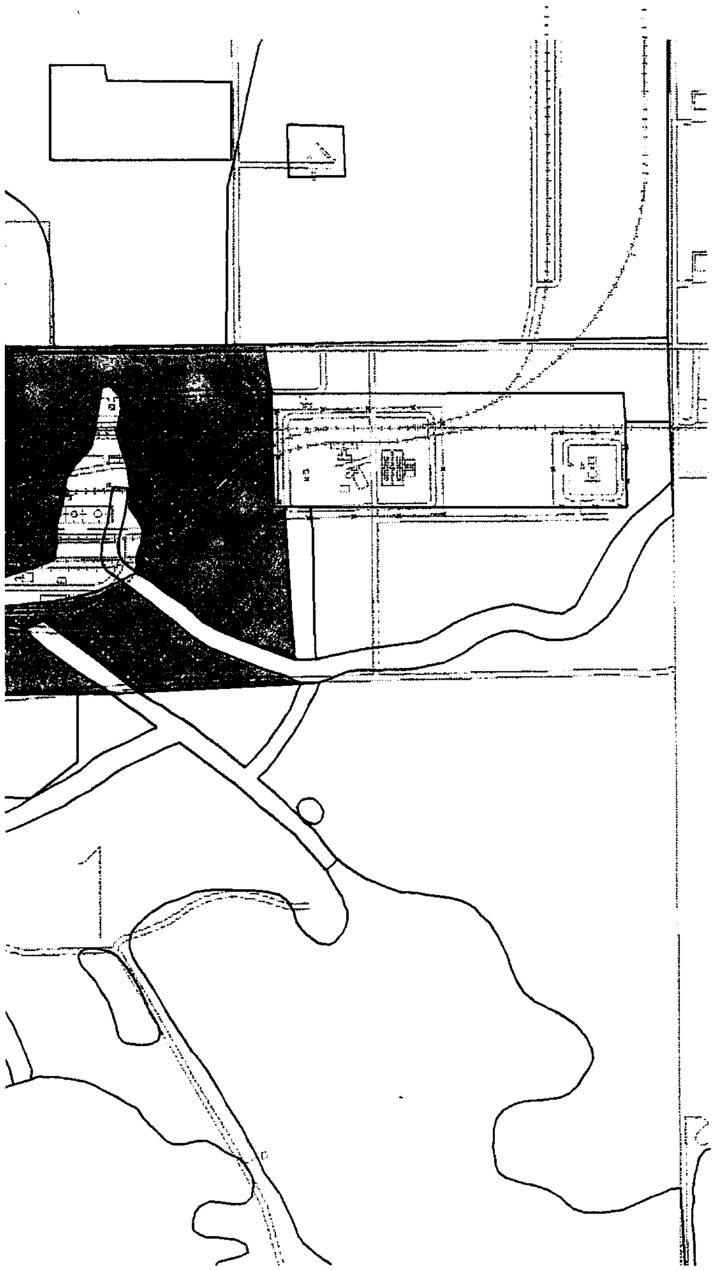


ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Biota Exceedance Area

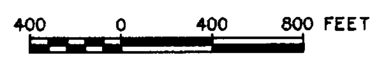
Human Health Exceedance Area

Principal Threat Exceedance Area

Site Boundary

Buildings and Roads

Section Number



Prepared for:

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for Rocky Mountain Arsenal

FIGURE 17.10-1

Exceedance Areas
South Plants Balance of Areas
Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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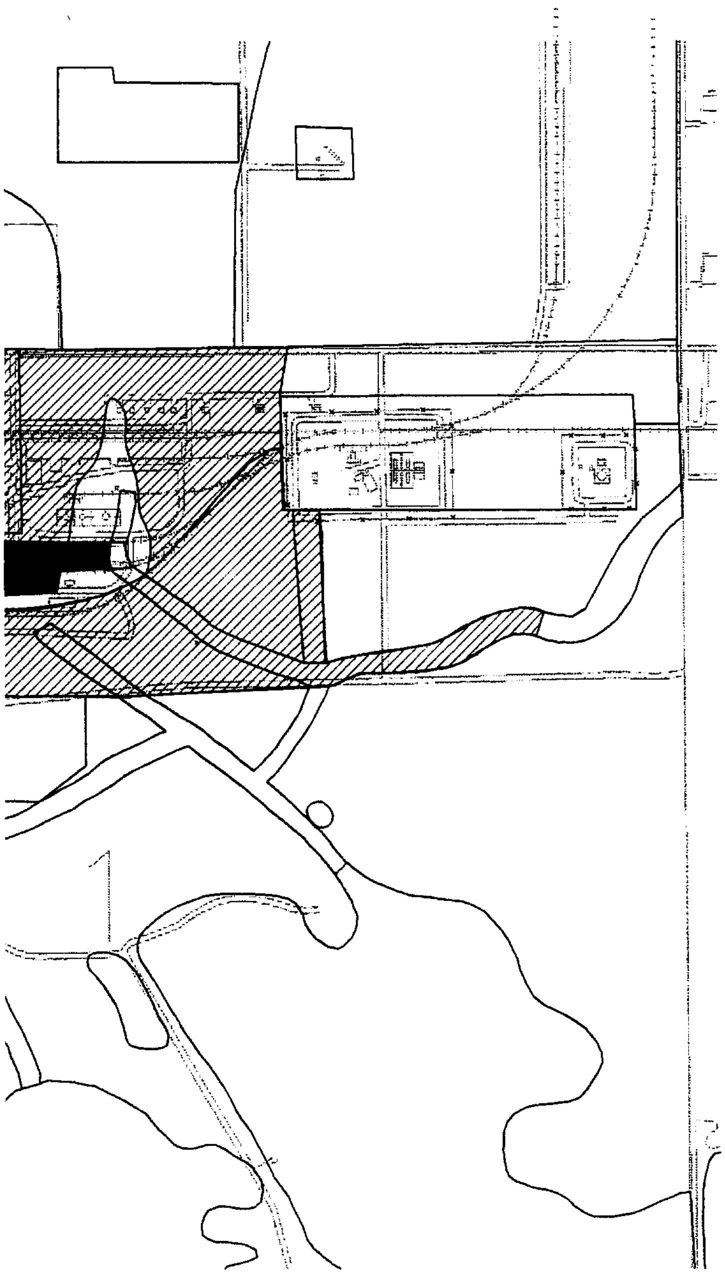
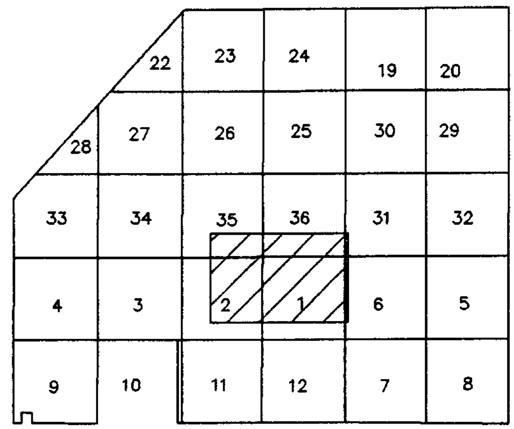


ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

- Human Health/Biota Exceedance Area
- Potential Agent Presence Area
- Potential UXO Presence Area
- Site Boundary
- Buildings and Roads
- Section Number

400 0 400 800 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 17.10-2

Potential Agent/UXO Presence Areas
South Plants Balance of Areas
Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

18.0 DETAILED ANALYSIS OF ALTERNATIVES FOR THE BURIED SEDIMENTS/DITCHES MEDIUM GROUP

The Buried Sediments/Ditches Medium Group consists of seven exceedance sites that contain either buried lake sediments or drainage ditches. These sites were grouped by type and contamination pattern to form two subgroups; Buried Sediments and Sand Creek Lateral. Figure 18.0-1 shows the location of the sites comprising these subgroups.

The primary Human Health and Biota COCs present in this medium group are OCPs. Chromium, CLC2A, and lead also exceed the Human Health SEC at scattered locations. Mercury and arsenic are present at levels above Biota SEC in some samples. The Sand Creek Lateral Subgroup is a potential source of groundwater contamination to several groundwater plumes (EBASCO 1992b). The Sand Creek Lateral is also a potential source of surface-water contamination as water flows through ditches in the site. Table 18.0-1 presents the characteristics of each subgroup, including COCs and exceedance volumes, and Appendix A details soils volumes and area estimates. Neither of these subgroups contain high levels of contamination that are considered principal threat areas.

In the DSA, alternatives were developed and screened based on the general characteristics of the medium group. However, the retained alternatives do not necessarily apply to each subgroup. The characteristics of the two subgroups—including contaminant types and contaminant concentrations, site configuration, and depth of contamination—were evaluated in the DAA to determine the subset of applicable alternatives for each subgroup from the range of alternatives retained in the DSA for the medium group. The alternatives evaluated for each subgroup are discussed in the following sections.

For each subgroup, the following sections present the characteristics of the subgroup, an evaluation of the retained alternatives against the DAA criteria listed in the NCP (EPA 1990), and the selection of a preferred alternative based on a comparative analysis of the alternatives. The preferred alternatives are as follows:

- Buried Sediments Subgroup: Alternative 6g—Excavation and consolidation of both human health and biota exceedance volumes in Basin A for containment with a clay/soil cap.

- Sand Creek Lateral Subgroup: Alternative 6g—Excavation and consolidation of both human health and biota exceedance volumes in Basin A for containment with a clay/soil cap.

18.1 BURIED SEDIMENTS SUBGROUP CHARACTERISTICS

The Buried Sediments Subgroup is composed of sites SSA-3a (Lake Ladora Sediments) and SSA-3b (Upper and Lower Derby Lake Sediments) (Figure 18.1-1). These sites contain contaminated sediments that were dredged from the adjacent lakes, deposited in unlined ditches at their current locations, and covered with approximately 18 inches of clean soil (EBASCO 1989b/RIC 89166R01). There is no clay layer or biota barrier between the cover soil and the contaminated sediments. Since lake dredging was completed in 1965, the covered sediment mounds have been allowed to revegetate naturally.

Table 18.1-1 provides a summary of contaminants, concentrations, and exceedance values for this subgroup and Table 18.1-2 summarizes the frequency of detections of contaminants above the Human Health and Biota SEC. The buried sediments from Lake Ladora (Site SSA-3a) do not contain contaminants above the Human Health SEC, but the Upper and Lower Derby Lake (Site SSA-3b) sediments contain maximum concentrations of dieldrin and chlordane above the Human Health SEC. The COCs for Derby Lake are found in the 4- to 10-ft depth interval. Both sites in the Buried Sediments Subgroup contain OCPs and mercury contamination at levels exceeding the Biota SEC throughout the 0- to 10-ft depth interval. The sites in this subgroup are physically well defined and easily accessible. Figure 18.1-1 shows the physical configurations and the distribution of exceedance areas for the Lake Ladora and the Upper and Lower Derby Lake sediment mounds, and Table 18.0-1 gives the exceedance areas and volumes.

Due to their location near the southern lakes (the southern tier), the sites in the Buried Sediments Subgroup exhibit high-quality habitat and wildlife potential. The native grasses present at the

site contribute to the site's value, but are replaceable through revegetation after any disturbance. These sites are also located within the Bald Eagle Management Area; therefore, the evaluation of alternatives for this subgroup must consider the impacts of alternatives on the habitat within these sites. Most alternatives consist of revegetating the areas disturbed with native grasses in accordance with a refuge management plan. As such, the habitat quality is restored for most alternatives. The institutional controls alternative prevents the use of the site as habitat and requires habitat mitigation efforts to offset this loss of habitat.

18.2 BURIED SEDIMENTS SUBGROUP EVALUATION OF ALTERNATIVES

The seven alternatives for the Buried Sediments Subgroup vary in approach from no action to treatment. Alternative 10: Solidification/Stabilization was deleted for this subgroup because organics (specifically OCPs) are the predominant COCs and this technology is not highly effective for organics. An additional alternative is considered in the DAA for this subgroup to evaluate consolidation of contaminated soils into Basin A (Alternative 6g: Caps/Covers with Consolidation). The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedances (which is listed first) and an alternative to address areas of biota exceedances (the "B" alternative).

18.2.1 Alternative 1/B1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), paired with Alternative B1: No Additional Action (Provisions of FFA), applies to all 59,000 SY of human health and biota exceedances in the Buried Sediments Subgroup. Although 180,000 BCY of contaminated sediments remain in place under this alternative, the potential for human exposure to contaminants is relatively low because the sediments are covered with clean soil and exceedances occur only at the 4- to 10-ft depth interval. There is no impact to existing habitat. The existing cover soils are monitored for vegetation damage and erosion processes as part of the long-term monitoring program. Untreated soils are monitored (approximately 13 total samples for the

subgroup per year) and 5-year site reviews are conducted to monitor the natural attenuation/degradation and potential migration of contaminants.

Table 18.2-1 presents an evaluation of Alternative 1 against the EPA criteria for the DAA. This alternative has low residual risk since there are no Human Health COCs in the Lake Ladora buried sediments and those in the buried sediments of Upper and Lower Derby Lake are at depths below 4 ft. However, the alternative does not satisfy RAOs as untreated soils remain in place without adequate controls being implemented. This alternative does not impact the existing habitat within these sites and may detract from the unrestricted use of the southern tier because contaminants are left in place. The total estimated present worth cost of this alternative is $960,000. Table B4.18-1 details the costing for this alternative.

18.2.2 Alternative 2/B2: Access Restrictions; Biota Management

Alternative 2: Access Restrictions (Modifications to FFA), paired with Alternative B2: Biota Management (Exclusion, Habitat Modification), applies to all 59,000 SY of human health and biota exceedances in the Buried Sediments Subgroup. Human and biota exposure to contaminants are reduced through the installation of 4,400-ft of perimeter chain-link fencing. In addition, the existing habitat is modified to reduce the value of the habitat, i.e., to exclude wildlife by revegetating the sites with a lower-quality vegetation that makes the area unappealing as habitat. An area of 59,000 SY is revegetated over a period of 3 years to ensure the growth of the grasses. The contaminants remain in place, but the exposure pathways are interrupted through the installation of fencing and habitat modifications. Long-term monitoring of untreated soils is conducted (approximately 13 samples for the subgroup per year) and 5-year site reviews are conducted to monitor damage to vegetation and damage from erosion processes.

Table 18.2-2 presents an evaluation of Alternative 2 against the EPA criteria for the DAA. This alterative satisfies the threshold criterion of overall protection, and it achieves Human Health and Biota RAOs with low residual risk. Access restrictions and fencing interrupt human health exposure pathways, and biota exposures are reduced by fencing and habitat modifications,

reducing the value of the habitat for biota. Although the exposure pathways are interrupted, this alternative reduces the total habitat by 59,000 SY and detracts from the unrestricted use of the southern tier. The loss of habitat associated with this alternative requires habitat mitigation in other areas of RMA. In addition, the site requires long-term management and maintenance of the fencing and planted vegetation for the alternative to remain effective. The total estimated present worth cost of this alternative is $1,200,000. Table B4.18-2 details the costing for this alternative.

18.2.3 Alternative 3/B3: Landfill

Alternative 3: Landfill (On-Post Landfill), paired with Alternative B3: Landfill (On-Post Landfill), addresses 180,000 BCY of contaminated soils associated with the Buried Sediments Subgroup. The contaminated soils are excavated and placed in a centralized on-post landfill (Section 4.6.6). Construction of the first cell of the multiple cell landfill and associated facilities takes 1 year. The landfill area is revegetated following installation of the cover and fencing. The landfill cell requires annual monitoring, long-term maintenance of the landfill cover, leachate collection and treatment, and groundwater monitoring. The excavations at the sites are backfilled to existing grade with soils from an on-post borrow area. The backfilled areas are covered with topsoil and revegetated, and the borrow area is recontoured and revegetated to restore habitat. However, fencing at the landfill excludes biota from that area.

Table 18.2-3 presents an evaluation of Alternative 3 against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through containment because the contaminated soils are excavated and transferred to the on-post landfill. The habitat value is restored both at the site and the borrow areas. Habitat mitigation is required to offset the loss in habitat value during the excavation of the high-quality habitat within this subgroup. The disposal of the 180,000 BCY of contaminated soils takes less than 1 year. The time frame required for attaining RAOs is 2 years, due to the time required for the construction of the landfill. The total estimated present worth cost of this alternative is $10,000,000. Table B4.18-3 details the costing for this alternative.

18.2.4 Alternative 6/B5: Caps/Covers

Alternative 6: Caps/Covers (Clay/Soil Cap), paired with Alternative B5: Caps/Covers (Clay/Soil Cap), addresses all human health and biota exceedance areas for the Buried Sediments Subgroup. Exposure pathways for both human health and biota are interrupted through the installation of a 59,000-SY compacted low-permeability soil cap with a biota barrier layer as described in Section 4.6. Prior to cap installation, the existing vegetation is cleared and the subsurface is compacted to minimize variations in the subgrade. Once the 2-ft layer of compacted, low-permeability soil is installed, a 1-ft biota barrier of cobbles and a 4-ft soil/vegetation layer that includes 6 inches of topsoil are installed. Materials for the cap are excavated from an on-post borrow area, except for topsoil, which is obtained off post. The borrow area is recontoured and revegetated to restore habitat. Based on the existing grade of the sites, additional grading fill is not required to achieve the design slope of 1.5 to 3 percent. This alternative is readily implemented, but the cap requires long-term management and maintenance of the vegetative cover for the alternative to remain effective. Five-year site reviews are performed.

Table 18.2-4 presents an evaluation of Alternative 6 against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs with acceptable residual risk since all contaminated soils/sediments are contained under a compacted clay cap and a biota barrier layer and the low-permeability soil cap can be reliably maintained. Habitat is restored for many species, but this alternative reduces the available habitat for burrowing animals through the biota barrier and detracts from the unrestricted use of the southern tier. The 59,000-SY compacted low-permeability soil cap is installed in less than 1 year. The total estimated present worth cost of this alternative is $4,600,000. Table B4.18-6 details the costing for this alternative.

18.2.5 Alternative 6g/B5a: Caps/Covers with Consolidation

Alternative 6g: Caps/Covers (Clay/Soil Cap) with Consolidation, paired with Alternative B5a: Caps/Covers (Clay Soil/Cap) with Consolidation, applies to all human health and biota exceedance volumes for the Buried Sediments Subgroup. Instead of being capped in place, the soils are consolidated in Basin A for containment under a low-permeability soil cap. (Section

4.6.9 discusses soil caps in depth.) This alternative is predicated on the selection of Alternative 6f for the Basin A Medium Group. The containment of Basin A requires grading fill to achieve the design grades for capping (the capping of Basin A is discussed in Section 10.2.3). The soils from this subgroup have lower contaminant levels than those in the Basin A Medium Group, so the 180,000 BCY of soils from the Buried Sediments Subgroup are transported to Basin A to serve as grading fill. The excavations are backfilled with soils from an on-post borrow area. The backfilled areas are covered with topsoil and revegetated and the borrow areas are recontoured and revegetated to restore habitat. Long-term of the monitoring of the site is not required since contaminants are removed.

Table 18.2-5 presents an evaluation of Alternative 6g against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through the containment of consolidated soils in Basin A. Since the contaminated soils are removed from the sites and placed in Basin A, there is a low residual risk and long-term monitoring of the site is not required. Habitat at the site is restored, and the habitat of the borrow area is restored. Habitat mitigation is required to offset the loss in habitat value during the excavation of the high-quality habitat within this subgroup. Although the consolidation of contaminated soils in Basin A for use as grading fill increases the mass of contaminants within Basin A, the installation of a compacted low-permeability soil cap substantially reduces the potential for migration of contamination to groundwater. Approximately 1 year is required to excavate and transport the contaminated soils to Basin A. The total estimated present worth cost of this alternative is $6,000,000. Table B4.18-6g details the costing for this alternative.

18.2.6 Alternative 13a/B6: Direct Thermal Desorption

Alternative 13a: Direct Thermal Desorption (Direct Heating), paired with Alternative B6: Direct Thermal Desorption (Direct Heating), treats 180,000 BCY of contaminated soils containing organic contaminants from the Buried Sediments Subgroup. These soils are excavated and transported to the centralized thermal desorption facility for treatment. The soils in this subgroup are classified as dry (i.e., moisture content of 10 percent). Based on this moisture content, the

processing rate for the centralized thermal desorption facility is approximately 2,000 BCY/day, with a discharge temperature of 300°C and a soils residence time of 30 minutes. Mercury in the soils is anticipated to be desorbed from the soils feed and recovered in the off-gas system. (Section 4.6.23 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the total soils feed is entrained in the desorber off-gas stream and recovered from the scrubber blowdown equipment. Due to elevated levels of mercury as well as salts, 1,800 BCY of blowdown particulates are placed in the on-post hazardous waste landfill. Follow-up solidification of the treated soil is not necessary since any residual inorganic COCs are at concentrations below either the Human Health or Biota SEC. The treated soils are returned as backfill to the sites. Since thermal desorption destroys the organic content in the treated soils, the site is covered with topsoil obtained off post and is revegetated with native grasses.

Table 18.2-6 presents an evaluation of Alternative 13a against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through treatment. Existing habitat is restored after regrading and revegetation. Habitat mitigation is required to offset the loss in habitat value during the excavation of the high-quality habitat within this subgroup. RAOs are achieved by this alternative only after a 3-year time frame. The thermal desorption of the 180,000 BCY of contaminated soils is accomplished in 1 year, but the construction and testing of the thermal desorber requires 2 years before the soils are treated. The total estimated present worth cost of this alternative is $26,000,000. Table B4.18-13a details the costing for this alternative.

18.2.7 Alternative 19a/B11a: In Situ Thermal Treatment

Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating), combined with Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating), treats 180,000 BCY of contaminated soils by in situ RF heating to thermally desorb organic contaminants. (Section 4.6 discusses RF heating.) To mobilize organic contaminants, the soils are heated to more than 250°C to a depth of 10 ft using vertical electrodes to deliver RF energy. The mobilized contaminants are then collected and treated in the off-gas treatment system as described in

Section 4.6.29. The subgroup requires one unit that can treat a 100-ft-long, 12-ft-wide, 10-ft-deep block of soils at a treatment rate of 180 BCY per day (based on a relatively dry moisture content). As in direct thermal desorption, mercury in the treated soils is anticipated to be volatilized by RF heating and reduced below the Biota SEC. The liquid sidestream from RF heating, which contains predominantly salts, is transported to the thermal desorption facility for treatment in the evaporator associated with the scrubber effluent as described in Section 4.6.8. As with thermal desorption, the treated soils exhibit a low residual organic carbon content, requiring the placement of imported topsoil to revegetate the treated areas with native grasses and thus restore habitat.

Table 18.2-7 presents an evaluation of Alternative 18a against the EPA criteria for the DAA. This alternative can theoretically achieve Human Health and Biota RAOs since OCPs and volatile metals can be driven from the soils by this form of in situ thermal desorption. Although the pilot-scale test of the RF technology at RMA failed to confirm the temperature distribution required for confident treatment of soils to achieve PRGs at the test site, the technology's DREs are sufficient to achieve both Human Health and Biota PRGs. The treated areas are revegetated to restore habitat. The implementability of in situ RF heating is questionable since there is no commercial source for the equipment and the technique is as yet unproven at full scale. The treatment of the 180,000 BCY of contaminated soils is feasible within 3 years. The total estimated present worth cost of this alternative is $95,000,000. Table B4.18-19a details the costing for this alternative.

18.3 BURIED SEDIMENTS SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Buried Sediments Subgroup contains 170,000 BCY of soils primarily contaminated with OCPs, although there are lower levels of mercury contamination present. The material in these sites is contaminated sediment that was dredged from the adjacent lakes in the Southern Study Area in the 1960s. Only 1 percent of the samples from these sites show OCPs exceeding the Human Health SEC, and a total of 11 percent of the samples show OCP exceedances of the Biota SEC. Two of the six biota exceedance compounds (aldrin and dieldrin) show average

concentrations above the Biota SEC in the biota exceedance volume. The human health risk is relatively low for this subgroup as the average concentrations in the human health exceedance volume are generally less than the Human Health SEC, and contaminated sediments are covered by approximately 18 inches of clean soil, which limits exposure pathways.

The sites in this subgroup exhibit high-quality habitat based on the vegetation present, their location near the southern lakes, and their location in the Bald Eagle Management Area; therefore, the selection of the preferred alternative must consider the impacts of alternatives on habitat. Areas disturbed during remediation are to be revegetated to restore the habitat value. In addition, the sites lie within the 100-year floodplain, so that exclusion or containment alternatives (Alternatives 2 and 6) would require additional surface water controls to modify the floodplain area.

Alternatives that involve excavation of human health exceedances require protection for site workers during remedial activities, but the short-term risk to workers is minimal with the use of proper PPE. The degree of contamination in sites in this subgroup does not necessitate special measures for odor control or community protection during remediation.

In summary, the Buried Sediments Subgroup contains OCP and mercury contamination at levels exceeding Biota SEC, and maximum concentrations of dieldrin and chlordane above the Human Health SEC at one site (SSA-3b). Worker and community protection are not significant factors in selection of the preferred alternative, but due to the high-quality habitat, the impact of alternatives on habitat is a significant consideration.

Alternative 1: No Additional Action is protective of human health, but does not achieve Biota RAOs as untreated soils remain without controls being implemented, and is eliminated from further consideration as the preferred alternative. The six remaining alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action-specific and location-specific ARARs for the DAA. The alternatives are

distinguished, however, by how well they satisfy the five balancing criteria (Tables 18.2-1 through 18.2-7).

Alternative 19a: In Situ Thermal Treatment achieves RAOs, but is unproven at full scale and is the most expensive of all the alternatives ($95,000,000). The five remaining remediation alternatives use adequate and reliable engineering controls, and are readily implemented. Alternative 2: Access Restrictions and Alternative 6: Caps/Covers eliminate or reduce available habitat in the southern tier and allow untreated contaminants to remain in place within the 100-year floodplain. Alternative 13a: Direct Thermal Desorption is the only remaining treatment alternative, but it has a higher cost ($26,000,000) than the alternatives that remove the contaminated soils from the sites and restore the habitat (Alternative 3: Landfill and Alternative 6g: Caps/Covers with Consolidation).

The preferred alternative for the Buried Sediments Subgroup is Alternative 6g: Caps/Covers with Consolidation. This alternative maximizes the overall cost effectiveness of remediation at RMA by consolidating soils removed from the Buried Sediments Subgroup sites at Basin A for use as grading fill. Consolidation reduces long-term monitoring and maintenance at RMA because the containment alternative for Basin A already includes a monitoring and maintenance program. This alternative is consistent with NCP guidance on engineering controls for low levels of contamination through contaminant removal and containment. This alternative minimizes long-term adverse impacts at the site and improves the habitat and is selected as the most cost-effective.

18.4 SAND CREEK LATERAL SUBGROUP CHARACTERISTICS

The Sand Creek Lateral Subgroup is composed of sites NCSA-5b (Drainage Ditches), NCSA-5c (Sand Creak Lateral), NPSA-4 (Fuse and Detonator Magazine Ditch), SSA-2b (Sand Creek Lateral), and WSA-6a (North Drainage Ditch). Two of these sites are continuous reaches of the Sand Creek Lateral in Sections 2 and 35 (Figure 18.4-1). The Sand Creek Lateral is an active drainage ditch that enters RMA at the southern boundary, travels north through Sections 2, 26,

and 35, and joins First Creek in Section 25. The Sand Creek Lateral serves as part of the RMA stormwater management system; flows are intermittent and include runoff from the South Plants Central Processing Area during storm events and snowmelt. Three sites are ditches that carried water to and from the secondary basins and drained the South Plants and North Plants processing areas. Site WSA-6a was used to drain surface-water runoff from the motor pool area in Section 4 (Figure 18.10-1).

Soil samples collected along these channel sites indicate that the COCs are present in the sediments through most of Section 2 and in isolated areas in Section 35 (Figure 18.4-2). Table 18.4-1 provides a summary of contaminants, concentrations, and exceedance values for this subgroup and Table 18.4-2 summarizes the frequency of detections for contaminants above the Human Health and Biota SEC. Maximum concentrations of OCPs, CLC2A, and ICP metals exceed the Human Health SEC. Human Health COCs extend to a depth of approximately 5 ft, with the highest contaminant concentrations detected in the upper 2 ft of the soil profile. All of the human health exceedance areas are contained in areas of biota exceedance. OCPs are present in the sediments above Biota SEC through most of the Sand Creek Lateral sites in Section 2 and Section 35 (Figure 18.2-2), and arsenic and mercury are present in the drainage ditches of this subgroup. Biota COCs extend to a depth of approximately 10 ft, with the highest concentrations detected in the upper 2 ft of the soil profile. Table 18.0-1 presents the exceedance areas and volumes for this subgroup.

Site NCSA-5c, the northern section of the lateral, has been tentatively identified as the source of two groundwater contaminant plumes, both of which originate in Section 35 (EBASCO 1992a/RIC 92017R01). The two Sand Creek Lateral Plumes occur in the unconfined aquifer and follow a buried paleochannel northwest into Section 27, where they merge with the Basin A Neck Plume. Sites NCSA-1c and NCSA-5b have been tentatively identified as contributors to the Basin A Neck Plume, which originates in Section 36. The plume occurs in the unconfined aquifer and follows a buried paleochannel northwest into Section 26 (EBASCO 1992a/RIC 92017R01). Both the Sand Creek Lateral Plumes and the Basin A Neck Plume are currently

intercepted by the Northwest Boundary Containment System (NWBCS). Although excavation and capping of the contaminated sediments in the Sand Creek Lateral may reduce or remove potential sources to the plumes, it is unlikely the NWBCS can be shut down after site remediation since it captures contaminants from additional sources. Coordination of soils alternatives with water alternatives for the Northwest Boundary Plume Group is required for alternatives involving excavation and capping.

Site WSA-6a has been tentatively identified as a contributor of VOCs to the Motor Pool Plume that originates in Section 4. The Motor Pool Plume is part of the Western Plume Group, which is currently intercepted by the Irondale Containment System and the South Adams County Water and Sanitation District well system. Groundwater alternatives for the Western Plume Group are not affected by remediation alternatives for the Sand Creek Lateral Subgroup.

Three structures are located in site WSA-6a. Therefore, coordination of alternatives developed for the structures medium with those developed for the soils medium is required. The excavation of the ditch entails the demolition of these structures and the removal of structural debris to allow access to subsurface soils.

The existing habitat quality within the Sand Creek Lateral Subgroup is considered moderate based on the types of vegetation encountered. However, the vegetation in the lateral is burned annually to improve surface-water flow, which reduces the value of the habitat to poor. The disturbed areas are revegetated with native grasses in accordance with a refuge management plan. As such, the habitat quality is improved for most alternatives.

18.5 SAND CREEK LATERAL SUBGROUP EVALUATION OF ALTERNATIVES

The five alternatives for the Sand Creek Lateral Subgroup vary in approach from no action to treatment. Three of the alternatives retained from the DSA were not applied to the Sand Creek Lateral Subgroup. Alternative 2: Access Restrictions was not evaluated for this subgroup because access restriction and biota controls are impractical and ineffective when applied to a

linear stream channel or ditch site; Alternative 10: Direct Solidification/Stabilization was not evaluated because the primary COCs are organics, which are not amenable to solidification; and Alternative 19: In Situ Thermal Treatment was not evaluated because the technology cannot be implemented in an active drainage ditch. The following subsections present a description of each alternative considered for the subgroup and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedances (which is listed first) and an alternative to address areas of biota exceedance (the "B" alternative).

18.5.1 Alternative 1/B1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), paired with Alternative B1: No Additional Action (Provisions of FFA), applies to all 44,000 SY of human health and biota exceedances for the Sand Creek Lateral Subgroup. No action is taken to reduce human or biota exposure to the contaminants and there is no impact on existing habitat. Contaminants remain in place and are accessible in surface soils, which may result in possible exposure or in the leaching of contamination to groundwater or surface water. Long-term monitoring of untreated soils is required. The sites are monitored (approximately 13 samples for the subgroup per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 18.5-1 presents an evaluation of Alternative 1 against the EPA criteria for the DAA. This alternative has a low residual risk since only low levels of OCPs, CLC2A, and ICP metals remain in the channel sediments and may impact human health and biota and surface water and groundwater quality. The alternative does not achieve Human Health or Biota RAOs except by natural attenuation/degradation over the long term since 39,000 BCY of contaminated soil is left in place without controls being implemented. The habitat is not improved. The total estimated present worth cost of this alternative is $930,000. Table B4.19-1 details the costing for this alternative.

18.5.2 Alternative 3/B3: Landfill

Alternative 3: Landfill (On-Post Landfill), paired with Alternative B3: Landfill (On-Post Landfill), addresses 39,000 BCY of contaminated soils. The soils are excavated and placed in a centralized, multiple cell on-post landfill (Section 4.6.6). Construction of one landfill cell and support facilities takes 1 year. After placement of waste, a cover and fence are installed and the cover is revegetated. The landfill cell requires long-term maintenance of the cover, leachate collection and treatment, and monitoring of potential leachate migration. Approximately 39,000 BCY of clean fill are backfilled to bring the ditches back to design grade. The borrow area for this fill is located on site. The backfilled excavations are covered with topsoil and revegetated and the borrow areas are recontoured and revegetated to restore habitat. Fencing is installed to exclude biota, which reduces the habitat value. Implementation of this alternative reduces the potential for groundwater and surface-water contamination for the Sand Creek Lateral.

Table 18.5-2 presents an evaluation of Alternative 3 against the EPA criteria for the DAA. This alternative achieves RAOs since contaminated soils are excavated and transferred to a containment cell. Habitat quality at the site is improved by removal of the contaminated soil and revegetation and the habitat at the borrow area is restored. The time frame to achieve RAOs for this alternative is 2 years, including 1 year to construct the landfill and 1 year to excavate and landfill the contaminated soils. The total estimated present worth cost of this alternative is $2,400,000. Table B4.19-3 details the costing for this alternative.

18.5.3 Alternative 6g/B5a: Caps/Covers with Consolidation

Alternative 6g: Caps/Covers (Clay/Soil Cap) with Consolidation, paired with Alternative B5a: Caps/Covers (Clay Soil/Cap) with Consolidation, applies to all human health and biota exceedance volumes for the Sand Creek Lateral Subgroup. Instead of being capped in place, the 39,000 BCY of contaminated soils are excavated and consolidated under the Basin A low-permeability soil cap. (Section 4.6 discusses clay/soil caps in detail.) This consolidation alternative is predicated on the selection of Alternative 6f for the Basin A Medium Group. As discussed in Section 10.2.3, the containment of Basin A requires a large amount of grading fill

to achieve the design grade for capping and the exceedance soils from this subgroup can be utilized as part of the required grading fill. Since the exceedance soils in this subgroup have lower contaminant levels than Basin A soils, the contaminant load in Basin A is not significantly increased. Excavated areas along the Sand Creek Lateral are backfilled with borrow soil obtained on site. The backfilled areas are covered with topsoil and revegetated to restore habitat.

Table 18.5-3 presents an evaluation of Alternative 6g against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through the consolidation of contaminated soils in Basin A. Exposure pathways for both human health and biota and the potential impacts on groundwater and surface-water quality are eliminated at the site since contaminated soils are removed and contained in Basin A. Long-term monitoring of the sites is not required. Habitat at the site is improved and the habitat of the borrow area is restored. Although the consolidation of contaminated soils in Basin A for grading fill increases the mass of contaminants within Basin A, the installation of the compacted clay cap substantially reduces the potential for migration of contamination to groundwater and surface water. The consolidation of 39,000 BCY of contaminated soils from the Sand Creek Lateral Subgroup is accomplished in 1 year. The total estimated present worth cost of this alternative is $1,500,000. Table B4.19-6g details the costing for this alternative.

18.5.4 Alternative 13a/B6: Direct Thermal Desorption

Alternative 13a: Direct Thermal Desorption (Direct Heating), paired with Alternative B6: Direct Thermal Desorption (Direct Heating), treats 39,000 BCY of contaminated soils. The soils are excavated and transported to the central thermal desorption facility for treatment. (Section 4.6.24 discusses thermal desorption in detail.) Based on the moisture content of the soils in this subgroup, i.e., dry, the processing rate for the thermal desorber facility is approximately 2,000 BCY/day with a discharge temperature of 300°C and a total soils residence time of 30 minutes. Due to the small volume of soils with ICP metals, the levels of ICP metals in the soils feed after homogenization are anticipated to be below Human Health SEC, indicating that treatment of inorganics is not required. (Section 4.6.24 discusses emission controls for off gases from thermal

desorption.) Approximately 1 percent of the total solids feed is entrained in the desorber off-gas stream and recovered from the scrubber blowdown equipment. Due to potentially elevated levels of some ICP metals (eg., lead) as well as salts, 390 BCY of blowdown particulates are placed in the on-post hazardous waste landfill. The treated soils are returned as backfill to the lateral. However, since thermal desorption removes the organic content in the soil, backfill is not used as topsoil. Instead, topsoil obtained off post is used to cover treated soils and is revegetated with native grasses to restore habitat.

Table 18.5-4 presents an evaluation of Alternative 13a against the EPA criteria for the DAA. This alternative achieves RAOs through treatment and reduces the migration of contaminants to surface water and groundwater. The habitat at the site is improved following revegetation. Thermal desorption of the 39,000 BCY of contaminated soils is accomplished 1 year after the construction of the thermal desorber, which is estimated to require 2 years. The total estimated present worth cost of this alternative is $5,500,000. Table B4.17-13 details the costing for this alternative.

18.6 SAND CREEK LATERAL SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Sand Creek Lateral Subgroup contains 39,000 BCY of exceedance soils primarily contaminated with OCPs, CLC2A, and ICP metals. This subgroup contains ditches contaminated by wastewater and runoff from site facilities and waste disposal basins. Approximately 4 percent of the samples for the subgroup exceed the Human Health SEC for OCPs and 9 percent of the samples exceed the Human Health SEC for CLC2A. A total of 17 percent of the samples exceed the Biota SEC for OCPs. The average concentrations of COCs in the human health exceedance volume is generally less than the Human Health SEC, indicating a relatively low human health risk. Concentrations in the biota exceedance volume are generally greater than the Biota SEC. There are no principal threat exceedances, but the ditches have been identified as sources or contributors to groundwater contamination plumes.

Habitat in the subgroup is generally considered poor based on the vegetation types present. The moderate-quality habitat found in the Sand Creek Lateral sites is burned every year to increase surface-water flow, which reduces the quality of the habitat to poor. Areas disturbed during remediation are to be revegetated to restore and improve habitat value.

Alternatives that involve excavation of human health exceedances require protection for site workers but the short-term risk to workers is minimal with the use of proper PPE. The degree of contamination in sites in this subgroup does not necessitate special measures for odor control or community protection during remediation.

In summary, the Sand Creek Lateral Subgroup contains low levels of contamination that exceed the Biota SEC and, in limited areas, also exceed the Human Health SEC. Habitat impacts and community protection are not deciding factors for consideration in selecting the preferred alternative for this subgroup.

Alternative 1: No Additional Action does not achieve the Biota RAOs and is not protective of human health and the environment. It is therefore eliminated from further consideration as the preferred alternative. The remaining three alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action-specific and location-specific ARARs for the DAA. Thus, the alternatives are distinguished by how they satisfy the balancing criteria (Tables 18.5-1 through 18.5-5).

All four alternatives exhibit similar long-and short-term effectiveness. Alternative 13a: Direct Thermal Desorption is the only treatment alternative. The cost of this alternative is significantly higher ($5,500,000) than the two containment alternatives. Alternative 6g: Caps/Covers with Consolidation has the lowest overall cost ($1,500,000).

The preferred alternative for the Sand Creek Lateral Subgroup is Alternative 6g: Caps/Covers with Consolidation. This alternative has a higher overall cost effectiveness than Alternative 3

since the contaminated soil removed from the Sand Creek Lateral sites can be used as a portion of the fill required to regrade Basin A for positive drainage prior to capping. In addition, long-term management and maintenance at RMA is reduced by consolidation of contaminated materials in Basin A (which includes a monitoring and maintenance program as part of its containment alternative) rather than landfilling or capping in place. Alternative 6g: Caps/Covers with Consolidation allows the Sand Creek Lateral to continue to convey surface water as it eliminates the potential for groundwater and surface-water contamination at the site. The selection of this alternative is consistent with NCP guidance (EPA 1990) regarding the use of engineering controls (containment) for low levels of contamination.

Table 18.0-1 Characteristics of the Buried Sediments Medium Group

Characteristic	Buried Sediments	Sand Creek Lateral
<u>Contaminants of Concern</u>		
Human Health	OCPs	CLC2A, OCPs, ICP Metals
Biota	OCPs, Hg	OCPs, As
<u>Exceedance Area (SY)</u>		
Total	59,000	44,000
Human Health	10,000	11,000
Biota	49,000	33,000
Potential Agent	Not applicable	Not applicable
Potential UXO	Not applicable	Not applicable
<u>Exceedance Volume (BCY)</u>		
Total	180,000	39,000
Human Health	27,000	14,000
Organic	27,000	11,000
Inorganic	0	2,200
Principal Threat	0	0
Biota	150,000	25,000
Potential Agent	Not applicable	Not applicable
Potential UXO	Not applicable	Not applicable
<u>Depth of Contamination (ft)</u>		
Human Health	4–10	0–5, mostly 0–1
Biota	0–10	0–10, mostly 0–5

Table 18.1-1 Summary of Concentrations for the Buried Sediments Subgroup

Contaminants of Concern	Range of Concentrations[1] (ppm)	Average Concentration[1] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
<u>Human Health Exceedance Volume</u>					
Dieldrin	9.0–51	30	40	400	0.83
Chlordane	BCRL–6.2	0.54	3.1	260	Not applicable
<u>Biota Exceedance Volume</u>					
Aldrin	BCRL–52	3.7	56	560	0.68
Dieldrin	BCRL–39	5.7	40	400	0.83
Endrin	BCRL–2.7	0.22	15	15,000	0.029
p,p,DDE	BCRL–0.51	0.012	130	1,300	0.2
p,p,DDT	BCRL–0.70	0.034	26	1,300	1.4
Mercury	BCRL–2.2	0.31	470	470,000	0.99

1 Based on modeled concentrations within exceedance volume.

Table 18.1-2 Frequency of Detections for Buried Sediments Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	224	190	84.8%	10	4.5%	24	10.7%	0	0.0%	0	0.0%
Benzene	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	93	89	95.7%	3	3.2%	--	--	1	1.1%	0	0.0%
Chlorobenzene	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
p,p,DDE	93	83	89.2%	8	8.6%	2	2.2%	0	0.0%	0	0.0%
p,p,DDT	92	83	90.2%	9	9.8%	0	0.0%	0	0.0%	0	0.0%
Dibromochloropropane	67	66	98.5%	1	1.5%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	67	67	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	222	166	74.8%	33	14.9%	20	9.0%	3	1.4%	0	0.0%
Endrin	227	213	93.8%	1	0.4%	13	5.7%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	92	91	98.9%	1	1.1%	--	--	0	0.0%	0	0.0%
Isodrin	92	86	93.5%	6	6.5%	--	--	0	0.0%	0	0.0%
Methylene Chloride	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Toluene	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	3	3	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	70	65	92.9%	5	7.1%	0	0.0%	0	0.0%	0	0.0%
Cadmium	70	69	98.6%	1	1.4%	--	--	0	0.0%	0	0.0%
Chromium	71	25	35.2%	46	64.8%	--	--	0	0.0%	0	0.0%
Lead	71	48	67.6%	23	32.4%	--	--	0	0.0%	0	0.0%
Mercury	256	190	74.2%	53	20.7%	13	5.1%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 18.2-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the Buried Sediments Subgroup

	CRITERIA	ALTERNATIVE EVALUATION
1.	Overall protection of human health and the environment	Achieves Human Health RAOs but not Biota RAOs as untreated soils remain at depth. Long-term reduction in toxicity of contaminants through natural attenuation.
2.	Compliance with ARARs	
	a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
	b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs. Buried Sediments Subgroup located in 100-year floodplain, but no actions initiated under alternative; Buried Sediments Subgroup not located in wetlands.
	c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3.	Long-term effectiveness and permanence	
	a) Magnitude of residual risks	a) Low residual risk. OCPs above Human Health SEC and OCPs and mercury above Biota SEC remain in soil and may impact biota.
		b) No controls implemented. Site reviews required.
	b) Adequacy and reliability of controls	c) Habitat quality not improved. Existing high-quality habitat not impacted by remedial alternative.
	c) Habitat impacts	
4.	Reduction in TMV	
	a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume or mobility except by natural attenuation; 180,000 BCY of untreated soils remain.
	b) Degree and quantity of TMV reduction	b) (See a.)
	c) Irreversibility of TMV reduction	c) (See a.)
	d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5.	Short-term effectiveness	
	a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
	b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
	c) Environmental impacts of remedial action	c) Minimal environmental impacts. Existing high-quality habitat not impacted by remedial alternative.
	d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction.
6.	Implementability	
	a) Technical feasibility	a) Technically feasible. No implementation action required.
	b) Administrative feasibility	b) Administratively feasible. No permitting required.
	c) Availability of services and materials	c) Monitoring services readily available.
7.	Present worth costs	
	a) Capital	a) $0
	b) Operating	b) $0
	c) Long-term	c) $960,000
	d) Total	d) $960,000

Table 18.2-2 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative B2: Biota Management (Exclusion, Habitat Modification) for the Buried Sediments Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs as human and biota exposure pathways interrupted through access restrictions and biota controls; no unacceptable short-term or cross-media impacts.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as access adequately controlled and site reviews conducted; endangered species not impacted, although habitat in southern tier slightly reduced.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Does not comply with location-specific ARARs as Buried Sediments Subgroup located in 100-year floodplain; surface-water controls could be constructed to modify 100-year floodplain; Buried Sediments Subgroups not located in wetlands.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. OCPs above Human Health SEC and OCPs and mercury above Biota SEC remain in place; fencing, land-use restrictions, and cultivation of lower-quality habitat reduce human and biota exposure.
b) Adequacy and reliability of controls	b) Adequate controls. Installation of fencing and land use restrictions reduce human exposure; controls adequate for small area; site reviews, long-term maintenance, and monitoring of wildlife exclusion required.
c) Habitat quality	c) Habitat quality eliminated within southern tier. Biota controls of fencing and cultivation of lower-quality habitat eliminate habitat for biota.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume or mobility except by natural attenuation for 180,000 BCY of untreated soils; human and biota exposure pathways interrupted over 59,000 SY by land-use restrictions, fencing, and biota controls.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Exposure controls reversible if fencing and biota controls fail.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative. Contaminants remain in place.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during fence installation and cultivation of lower-quality habitat.
b) Protection of community during remedial action	b) Protective of community. Dust and vapor emissions not anticipated.
c) Environmental impacts of remedial action	c) Moderate environmental impacts. Moderate impact on biota through elimination of high-quality habitat in southern tier.
d) Time until RAOs are achieved	d) 3 years. Installation of perimeter fencing within several months but cultivation of lower-quality habitat requires 3 years; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; additional remedial actions easily undertaken for soils left in place.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials readily available for fence installation and habitat modifications.
7. Present worth costs	
a) Capital	a) $150,000
b) Operating	b) $37,000
c) Long-term	c) $970,000
d) Total	d) $1,200,000

Table 18.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the Buried Sediments Subgroup

CRITERIA	ASSESSMENT OF ALTERNATIVE
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; no unacceptable short-term or cross-media impacts.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation; endangered species not impacted, although habitat in southern tier reduced during excavation.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as no permanent structures are constructed in 100-year floodplain; Buried Sediments Subgroup not located in wetlands; landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 180,000 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality restored at site. Revegetation of disturbed areas restores high-quality habitat at site, but eliminates poor-quality habitat at landfill; habitat mitigation required to offset loss in habitat value during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 180,000 BCY in on-post landfill.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial action	c) Moderate environmental impacts. Moderate impact to biota as high-quality habitat disturbed within the southern tier.
d) Time until RAOs are achieved	d) 2 years. Excavation of 180,000 BCY feasible within 1 year after 1 year for construction of on-post landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliable operated thereafter; landfill cells monitored; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $3,600,000
b) Operating	b) $5,910,000
c) Long-term	c) $730,000
d) Total	d) $10,000,000

Table 18.2-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternatives B5: Caps/Covers (Clay/Soil Cap) for the Buried Sediments Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained by clay/soil cap, preventing human and biota exposure; no unacceptable short-term or cross-media impacts.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted, although habitat in southern tier reduced.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Does not comply with location-specific ARARs as Buried Sediments Subgroup located in 100-year floodplain; surface-water controls could be constructed to modify 100-year floodplain; Buried Sediments Subgroup not located in wetlands.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 180,000 BCY of untreated soils contained with 59,000-SY clay/soil cap.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover maintenance required; high confidence in engineering controls of clay/soil cap, but additional controls required because sites are within 100-year floodplain.
c) Habitat impacts	c) Habitat quality restored. Revegetation of disturbed areas restores high-quality habitat; restrictions to burrowing animals help preserve integrity of cap and prevent exposure; habitat mitigation required to offset loss in habitat value.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 59,000-SY clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during installation of clay/soil cap.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial action	c) Moderate environmental impacts. Moderate impact to biota as existing high-quality habitat disturbed in southern tier; burrowing animals excluded from area.
d) Time until RAOs are achieved	d) 1 year. Installation of 59,000-SY clay/soil cap feasible within 1 year; natural attenuation of untreated soils ongoing.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials readily available for clay/soil cap construction; clay/soil caps well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $2,900,000
c) Long-term	c) $1,700,000
d) Total	d) $4,600,000

Table 18.2-5 Evaluation of Alternative 6g: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation for the Buried Sediments Subgroup

CRITERIA	ASSESSMENT OF ALTERNATIVE
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health and Biota SECs excavated and consolidated in Basin A for containment with clay/soil cap preventing exposure; no unacceptable short-term or cross-media impacts.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted although habitat in southern tier reduced during excavation.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as no permanent structures constructed in 100-year floodplain; Buried Sediments Subgroup not located in wetlands; Basin A not located in wetlands or 100-year floodplain.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 180,000 BCY of soils consolidated and contained in Basin A with clay/soil cap.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils in Basin A; high confidence in engineering controls of clay/soil cap in Basin A.
c) Habitat impacts	c) Habitat quality restored. Revegetation of disturbed high-quality habitat restores habitat; habitat mitigation required to offset loss in habitat value.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through consolidation of 180,000 BCY of contaminated soils and installation of clay/soil cap in Basin A.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if Basin A cap degrades of leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial action	c) Moderate environmental impacts. Moderate impact to biota as high-quality habitat disturbed within the southern tier.
d) Time until RAOs are achieved	d) 1 year. Consolidation of 180,000 BCY in Basin A feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative implemented within required time frame and reliably maintained thereafter; additional remedial actions require removal of cap/cover in Basin A.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials readily available for consolidation and clay/soil cap construction; clay/soil caps well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $6,000,000
c) Long-term	c) $0
d) Total	d) $6,000,000

Table 18.2-6 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the Buried Sediments Subgroup

CRITERIA	ASSESSMENT OF ALTERNATIVE
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to OCP detection levels and mercury removed below Biota SEC; blowdown solids placed in on-post landfill; no unacceptable short-term or cross-media impacts.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation achieved; endangered species not impacted, although habitat reduced in southern tier during excavation.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as no permanent structures are constructed in the 100-year floodplain; Buried Sediments Subgroup not located in wetlands; thermal desorption facility and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk meets PRGs. 180,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality restored. Revegetation of disturbed areas restores existing high-quality habitat; habitat mitigation required to offset loss in habitat value.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 180,000 BCY thermally desorbed to degrade OCPs and remove mercury.
b) Degree and quantity of TMV reduction	b) OCPs reduced below detection levels (>99.99% destruction removal efficiency); TMV of OCPs eliminated; mercury removed below Biota SEC; scrubber blowdown solids from off-gas treatment equipment with mercury and salts placed in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 1,800 BCY of blowdown solids with mercury and salts landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated from excavation; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial action	c) Moderate environmental impacts. Moderate impact to biota as high-quality habitat disturbed within the southern tier.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 180,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility and landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitored.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $5,500,000
b) Operating	b) $21,000,000
c) Long-term	c) $7,000
d) Total	d) $26,000,000

Table 18.2-7 Evaluation of Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative B11a: In Situ Thermal Treatment (RF/Microwave Heating) for the Buried Sediments Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through treatment, but concentrations not reduced to achieve PRGs for point of departure; no unacceptable short-term or cross-media impacts.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs including state regulations on air emissions sources; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as no permanent structures constructed in 100-year floodplain; Buried Sediments Subgroup not located in wetlands.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 180,000 BCY thermally treated in place but PRGs not achieved; reduction in OCP levels are within acceptable levels for human health (10^{-4} to 10^{-6} excess cancer risk).
b) Adequacy and reliability of controls	b) Controls not required. Monitoring of treated soils not required.
c) Habitat impacts	c) Habitat quality restored. Revegetation of disturbed areas restores habitat, but some biota risk remains as Biota PRGs not achieved; habitat mitigation required to offset loss in habitat during treatment.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 180,000 BCY thermally treated to degrade OCPs and remove mercury.
b) Degree and quantity of TMV reduction	b) Reductions from RF heating (>99% destruction removal efficiency) unable to achieve PRGs. TMV of OCPs reduced during RF treatment but concentrations after treatment not able to achieve PRGs; OCP levels in treated soils within acceptable range for human health (10^{-4} to 10^{-6} excess cancer risk); mercury condensed in blowdown liquid.
c) Irreversibility of TMV reduction	c) TMV reduction by in situ RF heating irreversible.
d) Type and quantity of treatment residuals	d) Liquid blowdown sidestream with elevated salts and mercury treated at thermal desorption facility with scrubber effluent.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during in situ thermal treatment.
b) Protection of community during remedial action	b) Protective of community. No fugitive dust emissions; vapor emissions associated with RF heating unit controlled by air emission control equipment.
c) Environmental impacts of remedial action	c) Moderate environmental impacts. Moderate impact to biota due to high habitat value within the southern tier.
d) Time until RAOs are achieved	d) 3 years. RF treatment of 180,000 BCY feasible within 3 years.
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of RF heating on soil with similar contaminants but unproven at full scale; additional remedial actions easily undertaken for treated soils that do not achieve PRGs.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system siting, design, and operating regulations.
c) Availability of services and materials	c) Limited availability. Equipment custom designed for each application and not available; specialists only available through process licensor IITRI; no full-scale demonstration of RF equipment.
7. Present worth costs	
a) Capital	a) $16,000,000
b) Operating	b) $79,000,000
c) Long-term	c) $0
d) Total	d) $95,000,000

Table 18.4-1 Summary of Concentrations for the Sand Creek Lateral Subgroup

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–260	27.3	56	560	0.68
Dieldrin	BCRL–130	32	40	400	0.83
Isodrin	BCRL–4.0	2.0	3.4	3,400	Not applicable
Chlordane	BCRL–10	1.31	3.1	260	Not applicable
Chloroacetic Acid[1]	230	Not applicable	74	74,000	Not applicable
Chromium[1]	490	43.7	40	10,000	Not applicable
Lead[1]	2,000	1,200	1,900	1,000,000	Not applicable
p,p,DDE[2]	BCRL–0.57	0.18	130	1,300	0.2
p,p,DDT[2]	BCRL–6.0	3.0	26	1,300	1.4
Biota Exceedance Volume					
Aldrin	BCRL–28	4.8	56	560	0.68
Dieldrin	BCRL–25	3.8	40	400	0.83
Endrin	BCRL–3.5	0.23	15	15,000	0.029
p,p,DDE	BCRL–4.6	0.39	130	1,300	0.2
Arsenic	BCRL–190	26	530	5,300	16.5
Mercury	BCRL–2.3	1.1	470	470,000	0.99

1 Reported as an isolated exceedance.
2 Present above Biota SEC only, but was detected in the human health exceedance volume.

Table 18.4-2 Frequency of Detections for Sand Creek Lateral Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	209	147	70.3%	27	12.9%	29	13.9%	6	2.9%	0	0.0%
Benzene	53	53	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	68	68	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	197	182	92.4%	13	6.6%	--	--	2	1.0%	0	0.0%
Chloroacetic Acid	11	9	81.8%	1	9.1%	--	--	1	9.1%	0	0.0%
Chlorobenzene	71	68	95.8%	3	4.2%	--	--	0	0.0%	0	0.0%
Chloroform	69	67	97.1%	2	2.9%	--	--	0	0.0%	0	0.0%
p,p,DDE	204	171	83.8%	22	10.8%	11	5.4%	0	0.0%	0	0.0%
p,p,DDT	210	176	83.8%	33	15.7%	1	0.5%	0	0.0%	0	0.0%
Dibromochloropropane	121	120	99.2%	1	0.8%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	68	68	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	14	14	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	118	118	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	220	111	50.5%	63	28.6%	38	17.3%	8	3.6%	0	0.0%
Endrin	203	168	82.8%	10	4.9%	25	12.3%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	196	184	93.9%	12	6.1%	--	--	0	0.0%	0	0.0%
Isodrin	204	178	87.3%	24	11.8%	--	--	2	1.0%	0	0.0%
Methylene Chloride	67	66	98.5%	1	1.5%	--	--	0	0.0%	0	0.0%
Tetrachloroethane	2	2	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	68	68	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Toluene	53	52	98.1%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	68	67	98.5%	1	1.5%	--	--	0	0.0%	0	0.0%
Arsenic	167	116	69.5%	42	25.1%	9	5.4%	0	0.0%	0	0.0%
Cadmium	199	163	81.9%	36	18.1%	--	--	0	0.0%	0	0.0%
Chromium	199	55	27.6%	138	69.3%	--	--	6	3.0%	0	0.0%
Lead	199	107	53.8%	91	45.7%	--	--	1	0.5%	0	0.0%
Mercury	186	144	77.4%	39	21.0%	3	1.6%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 18.5-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA) for the Sand Creek Lateral Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and the environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants due to natural attenuation; surface-water and groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sand Creek Lateral Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. ICP metals, CLC2A, and OCPs above Human Health SEC and OCPs, arsenic, and mercury above Biota SEC remain in surface soils and may impact human health and biota.
	b) No controls implemented. Site review, groundwater, and surface-water monitoring required.
b) Adequacy and reliability of controls	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
c) Habitat impacts	
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility except by natural attenuation; 39,000 BCY of untreated soils remain.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial action	c) Minimal environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater and surface water not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $930,000
d) Total	d) $930,000

Table 18.5-2 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill) for the Sand Creek Lateral Subgroup

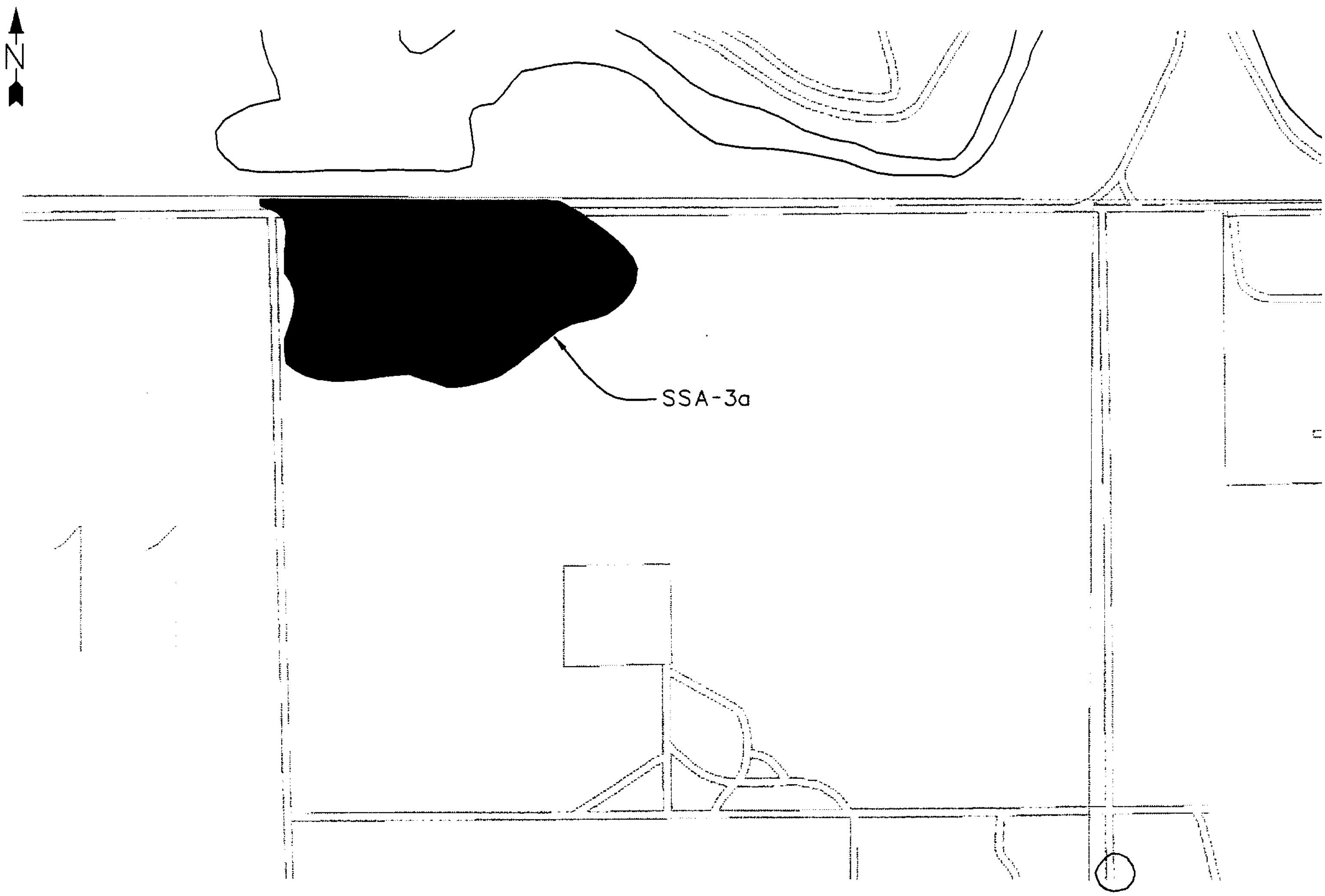
CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; groundwater and surface-water impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation achieved; LDRs not triggered; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sand Creek Lateral Subgroup and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 39,000 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site, but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 39,000 BCY in on-post landfill.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial action	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to surface water and groundwater reduced.
d) Time until RAOs are achieved	d) 2 years. Excavation of 39,000 BCY feasible within 1 year after 1 year for construction of on-post landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $780,000
b) Operating	b) $1,500,000
c) Long-term	c) $160,000
d) Total	d) $2,400,000

Table 18.5-3 Evaluation of Alternative 6g: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation for the Sand Creek Lateral Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health and Biota SECs excavated and consolidated in Basin A for containment with clay/soil cap, preventing exposure; groundwater and surface water impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sand Creek Lateral Subgroup and Basin A not located in wetlands or 100-year floodplain.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 39,000 BCY of soils consolidated and contained in Basin A with caps/covers.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils in Basin A; high confidence in engineering controls of clay/soil cap in Basin A.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed poor-quality habitat improves habitat, offsetting habitat loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through consolidation of 39,000 BCY of contaminated soils and installation of clay/soil cap in Basin A.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if Basin A cap degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation and transportation.
b) Protection of community during remedial action	b) Protective of community. Controls adequate to minimize fugitive dusts; vapor emissions not anticipated.
c) Environmental impacts of remedial action	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater and surface water reduced.
d) Time until RAOs are achieved	d) 1 year. Consolidation of 39,000 BCY in Basin A feasible within 1 year.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative implemented within required time frame and reliably maintained thereafter; additional remedial actions require removal of cap/cover in Basin A.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily available. Equipment, specialists, and materials readily available for consolidation and clay/soil cap construction; clay/soil caps well documented at full scale.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $1,500,000
c) Long-term	c) $0
d) Total	d) $1,500,000

Table 18.5-4 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating) for the Sand Creek Lateral Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and the environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to OCP detection levels and inorganics reduced below Human Health SEC; blowdown solids placed in on-post landfill; groundwater and surface-water impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation achieved; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Sand Creek Lateral Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 39,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 39,000 BCY thermally desorbed to degrade OCPs.
b) Degree and quantity of TMV reduction	b) OCPs and CLC2A reduced below detectable levels (>99.99% destruction removal efficiency); TMV of OCPs eliminated; ICP metals reduced below Human Health SEC following solids blending as a pre-treatment and limited volatilization during thermal desorption; scrubber blowdown-solids with ICP metals and salts from off-gas treatment equipment placed in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 390 BCY of blowdown solids with ICP metals and salts landfilled.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; vapor emissions not anticipated from excavation; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial action	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to surface water and groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation and treatment of 39,000 BCY feasible within 1 year after 2 years for construction of thermal desorption facility and landfill.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitored.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $1,100,000
b) Operating	b) $4,300,000
c) Long-term	c) $2,000
d) Total	d) $5,500,000



LEGEND

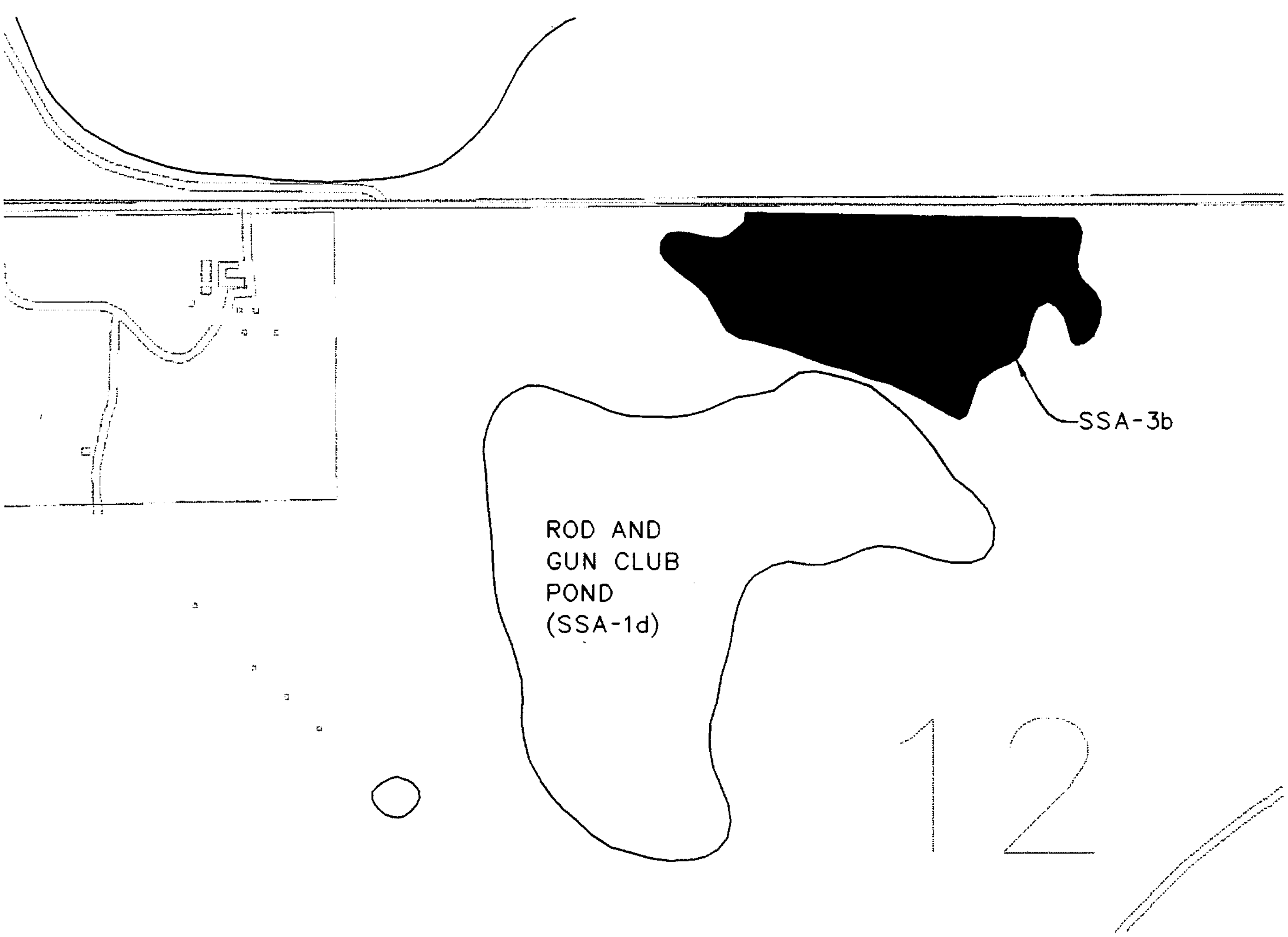
Buried Sediments Subgroup
SITES: SSA-3a, Lake Ladora Sediments
SSA-3b, Derby Lakes Sediments

Site Boundary

Buildings and Roads

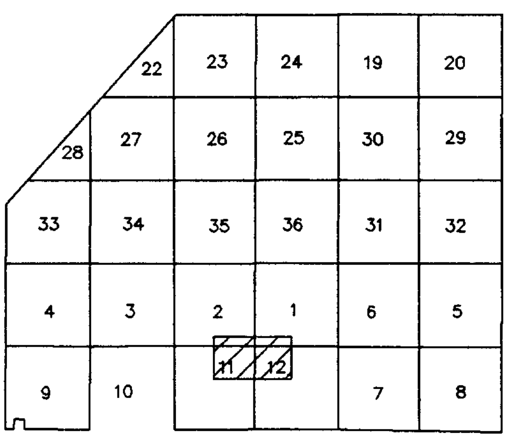
11 Section Number

REVISION NO. 0
FILE NAME 20110\32\F02-004.DWG
DATE 3/2/93
DRAWN BY EMH
APPROVED BY
CHECKED BY



250 0 250 500 FEET

ROCKY MOUNTAIN ARSENAL
INDEX MAP



Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 18.0-1

Site Locations
Buried Sediments Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

CHECKED BY

APPROVED BY

DRAWN BY EMH

DATE 3/2/93

FILE NAME 20110\32\F02-005.DWG

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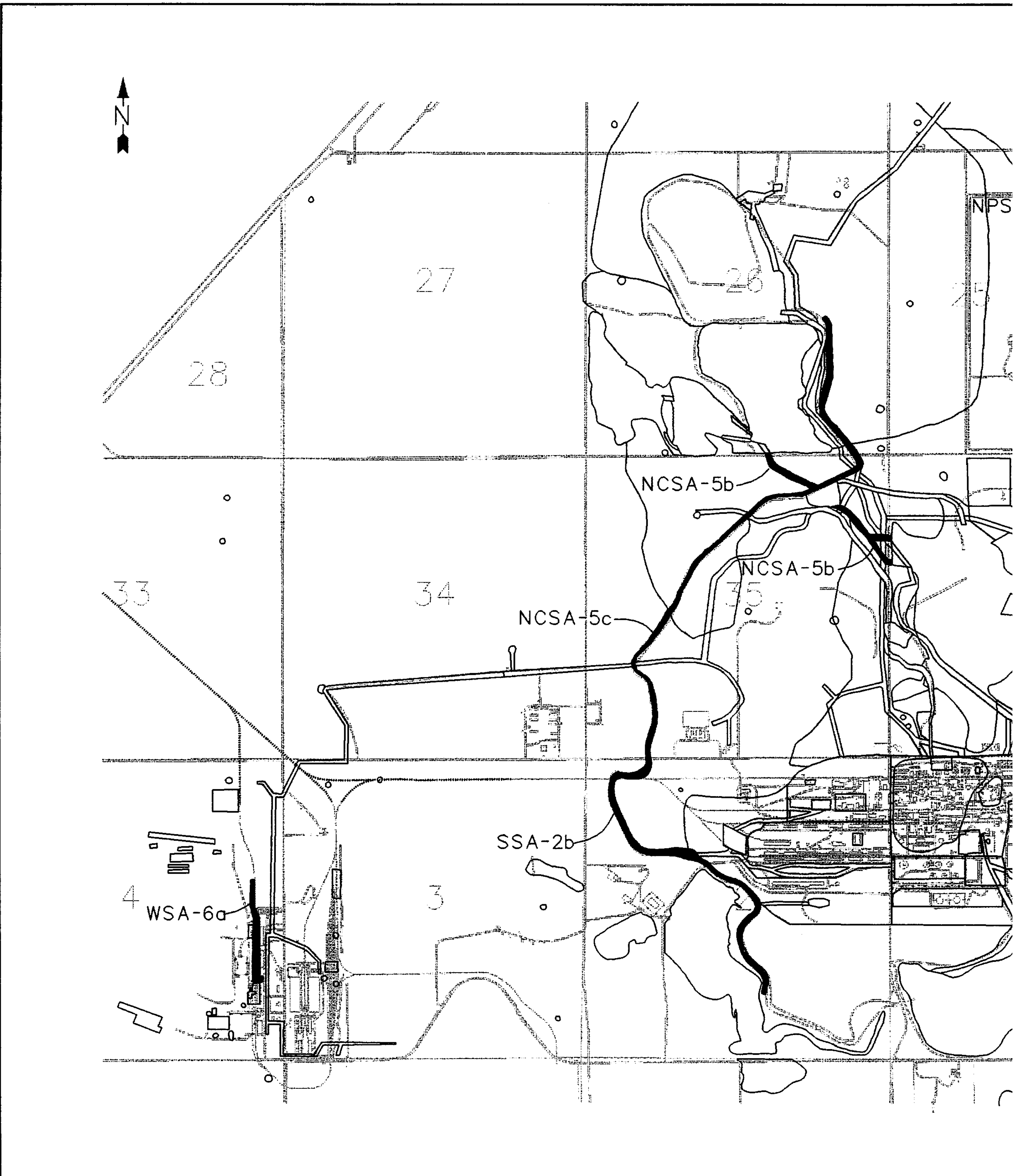
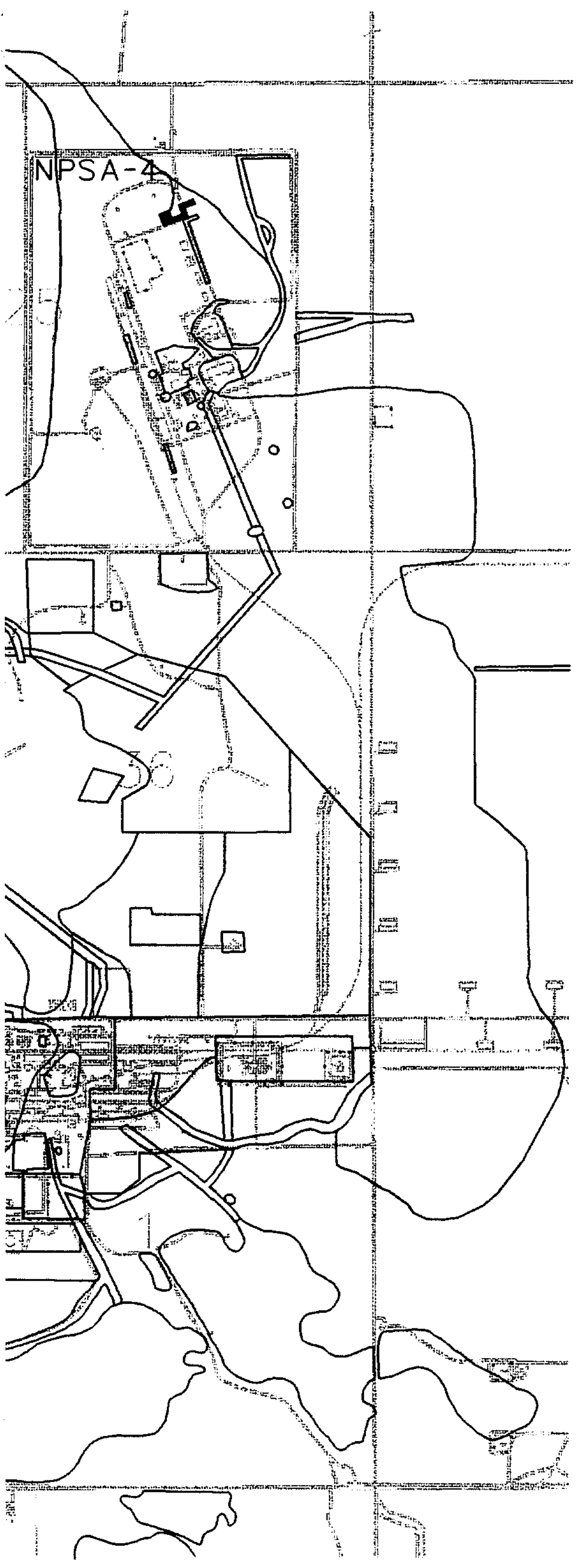
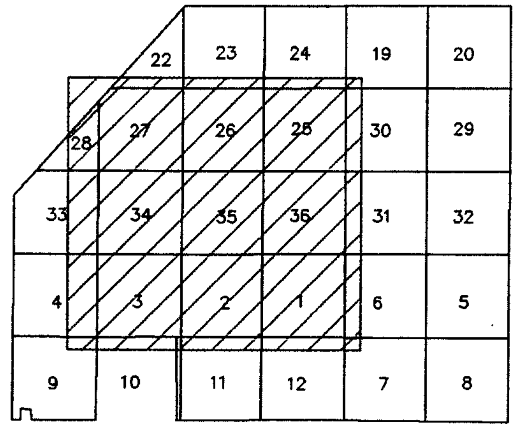




ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

SITES: SSA-2b, Sand Creek Lateral
NCSA-5c, Sand Creek Lateral
NCSA-5b, Drainage Ditches
NPSA-4, Fuse and Detonator Magazine
WSA-6a, Motor Pool Ditch

Site Boundary

Buildings and Roads

2 Section Number

600 0 600 1200 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 18.0-2

Site Locations
Sand Creek Lateral Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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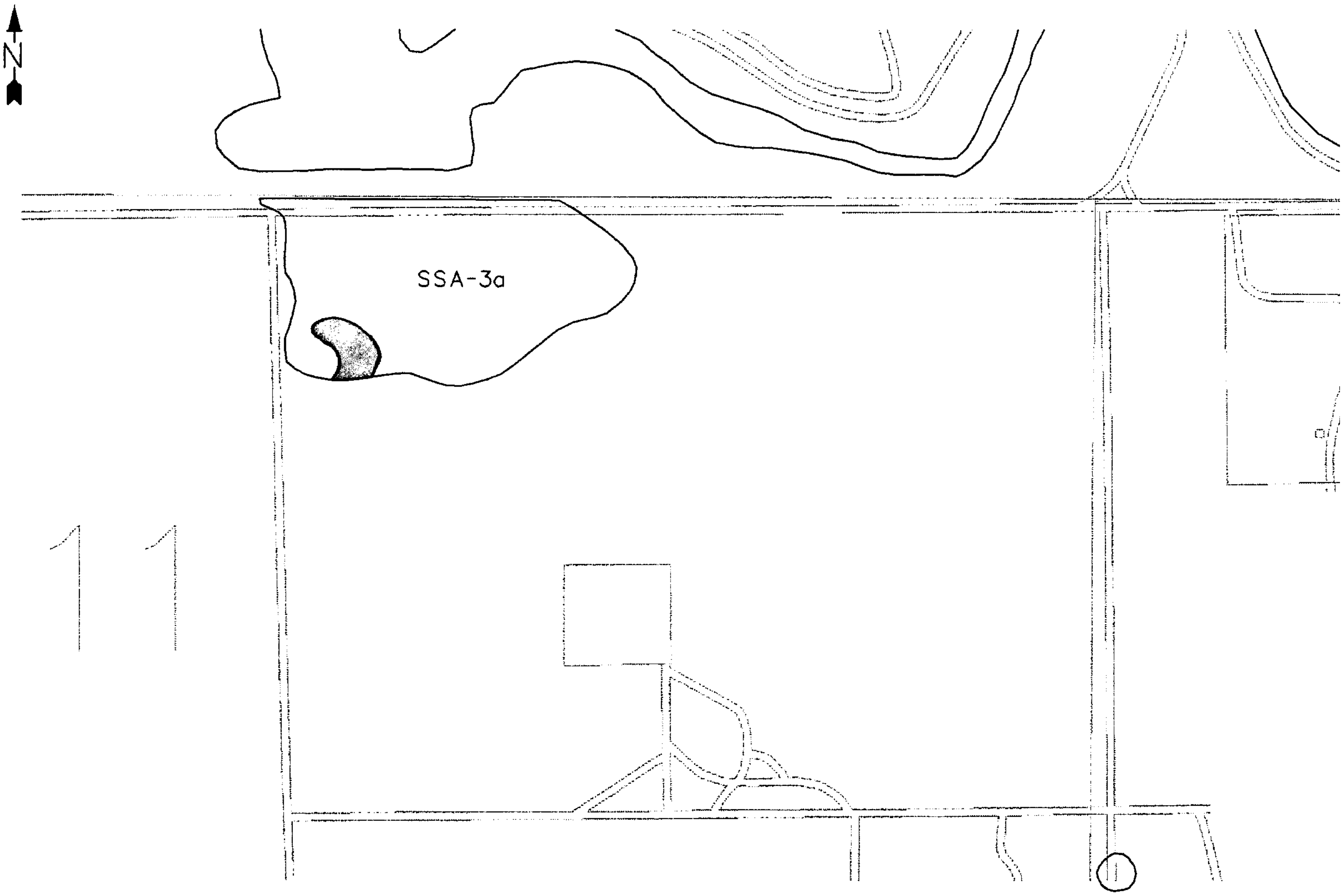


LEGEND

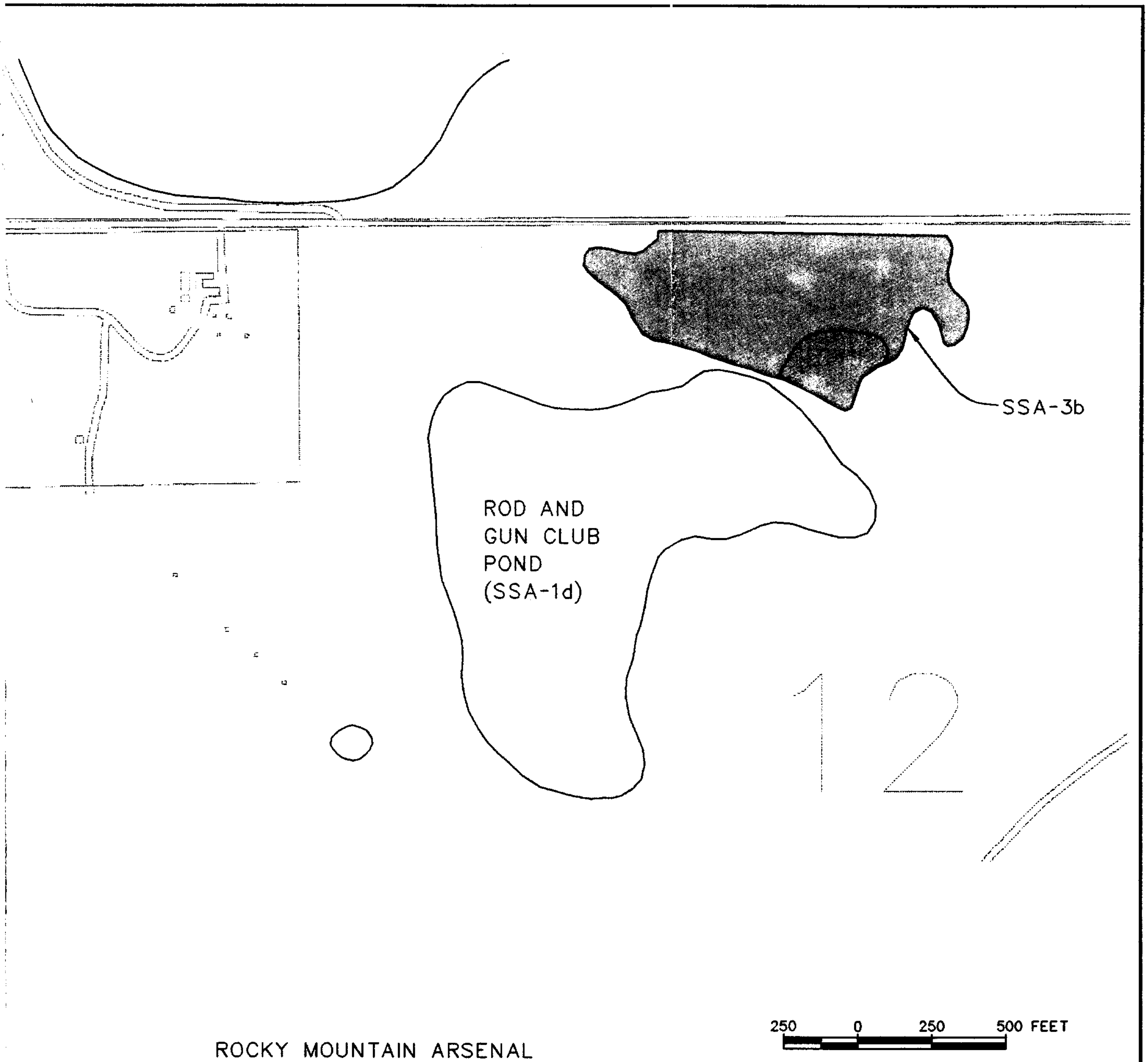
Biota Exceedance Area

Human Health Exceedance Area

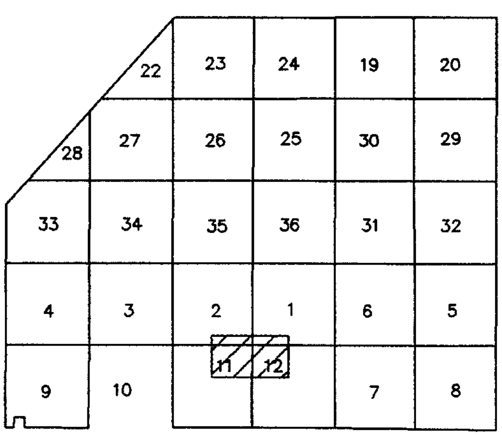
Site Boundary

Buildings and Roads

11 Section Number



ROCKY MOUNTAIN ARSENAL
INDEX MAP



Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 18.1-1

Exceedance Areas
Buried Sediments Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

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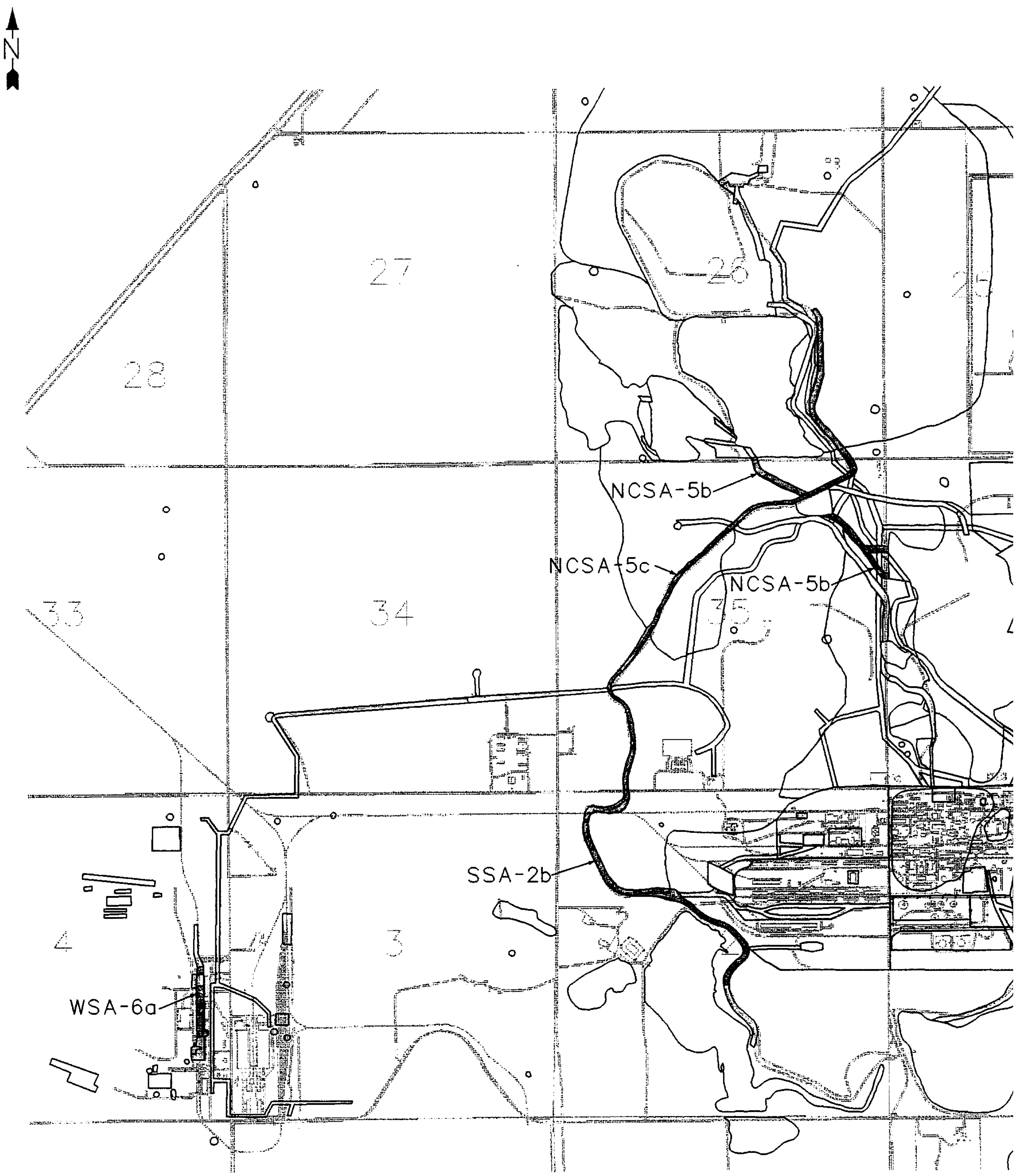
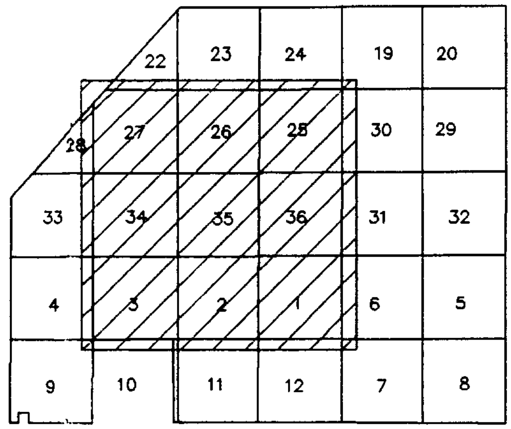
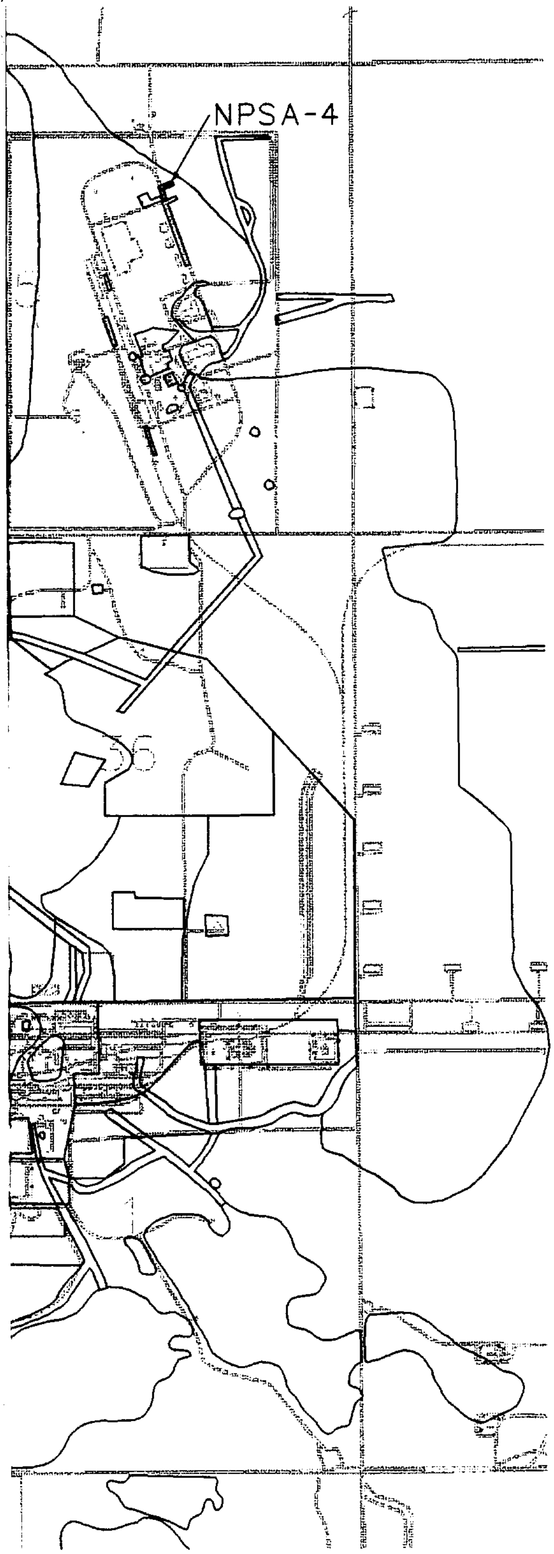


ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Biota Exceedance Area

Human Health Exceedance Area

Site Boundary

Buildings and Roads

2 Section Number

1100 0 1100 2200 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 18.4-1

Exceedance Areas
Sand Creek Lateral Subgroup

Rocky Mountain Arsenal.
Prepared by: Ebasco Services Incorporated

19.0 DETAILED ANALYSIS OF ALTERNATIVES FOR THE UNDIFFERENTIATED MEDIUM GROUP

The Undifferentiated Medium Group is composed of seven sites with varying site-type characteristics or contamination patterns. These sites are either located in the southeast corner of Section 36 or are buried trenches located in the Eastern Study Area and were divided into subgroups—Section 36 Balance of Areas and Burial Trenches—on the basis of their geographic distribution. Figure 19.0-1 shows the location of the subgroups and their related sites.

The primary Human Health and Biota COCs in this medium group are OCPs, although CLC2A and ICP metals were also found at concentrations above the Human Health SEC. Portions of the Undifferentiated Medium Group contain arsenic and mercury above the Biota SEC, but not above human health levels. Most sites within this medium group also exhibit the potential for UXO and agent presence. Sites within the Section 36 Balance of Areas Subgroup are also potential sources of groundwater contamination based upon the migration pathways identified in the RISR (EBASCO 1992a/RIC 92017R01). Table 19.0-1 presents the characteristics of this medium group including exceedance volumes, and COCs and Appendix A presents the details of volume and area calculations.

In the DSA, alternatives were developed and screened based on the general characteristics of the medium group. However, the retained alternatives do not necessarily apply to each subgroup. The characteristics of the two subgroups—including contaminant types and contaminant concentrations, site configuration, and depth of contamination—were utilized to determine the subset of applicable alternatives for each subgroup from the range of alternatives retained in the DSA for this medium group.

The following sections present the characteristics of each subgroup, an evaluation of the retained alternatives for the subgroup against the DAA criteria listed in the NCP (EPA 1990a), and the selection of a preferred alternative based on a comparative analysis of the alternative evaluations. The preferred alternatives for the two subgroups are as follows:

- Section 36 Balance of Areas: Alternative 6g—Excavation and consolidation of exceedance areas in Basin A for containment following agent screening and UXO clearance.

- Burial Trenches: Alternative 3—Excavation of contaminated soils and disposal in the on-post landfill following agent screening and UXO clearance.

19.1 SECTION 36 BALANCE OF AREAS SUBGROUP CHARACTERISTICS

The Section 36 Balance of Areas Subgroup is composed of sites CSA-1b (Complex Disposal Area South), CSA-2a (Munitions Testing Area), and CSA-4 (Balance of Areas Investigated) (Figure 19.0-1). Contamination histories are varied for these sites, but these areas exhibit the potential presence of agent and UXO. The principal threat criteria were not exceeded at any of the sites in this subgroup.

Table 19.1-1 provides a summary of contaminants, concentrations, and exceedance values for this subgroup and Table 19.1-2 summarizes the frequency of detections of contaminants above the Human Health and Biota SEC. Maximum concentrations of OCPs and CLC2A exceed the Human Health SEC in 150,000 BCY at depths ranging from 0 to 10 ft below ground. Site CSA-1b contains the majority of the human health exceedances (Figure 19.1-1). Figure 19.1-2 presents the overlap of areas potentially containing agent or UXO with the human health and biota exceedance areas. OCPs and mercury exceed the Biota SEC in 240,000 BCY, with maximum concentrations ranging from 2.8 ppm for DDT to 31 ppm for dieldrin. These COCs were detected to a depth of 5 ft below ground surface, although most of these contaminants were detected in the 0- to 1-ft depth interval. As shown in Figure 19.1-1, the majority of the 520,000 SY of biota exceedances are located within site CSA-4.

The area within the Section 36 Balance of Areas Subgroup is a poor-quality habitat based on the vegetation types encountered. The disturbed areas are revegetated with native grasses following remediation, so the overall habitat value is improved through remedial actions. However, the institutional controls alternative results in the removal of 640,000 SY from use as habitat.

Site CSA-1b within the Section 36 Balance of Areas Subgroup has been identified as a contributing source to a groundwater contamination plume. The plume occurs in the unconfined aquifer and is part of the Basin A Plume Group, which follows the Basin A Neck paleochannel to the northwest where it is intercepted and treated by the Basin A Neck IRA treatment system. Groundwater alternatives that address improved performance for the Basin A Neck IRA treatment system or the mass reduction of individual plumes or groups are being evaluated for the Basin A Plume Group. Coordination of alternatives developed for the soils medium with those for the water medium is limited to source excavation or capping. Coordination of alternatives developed for the water medium is also required for those alternatives that include dewatering during excavation. Due to the contaminant mass loading already in the aquifer, it is unlikely that the remediation of the Section 36 Balance of Areas Subgroup will allow the Basin A Neck system or the boundary systems to be shut down. Site CSA-2a contains several structures included in the No Future Use, Manufacturing History and No Future Use, Agent History Medium Groups in the structures medium (Figure 19.1-1). To excavate the contaminated soils that may be present beneath these structures, the structures are demolished and the resulting debris removed from the site.

19.2 SECTION 36 BALANCE OF AREAS SUBGROUP EVALUATION OF ALTERNATIVES

The six alternatives for the Section 36 Balance of Areas Subgroup vary in approach from no action to treatment. An additional alternative was developed during the DAA to include the consolidation of contaminated soils at Basin A. In addition, an in situ treatment alternative, Alternative 19a, was added for this subgroup since only a relatively small area within the subgroup contains significant amounts of subsurface debris that would hinder treatment. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedance areas (which is listed first), an alternative to address biota exceedance areas (the "B" alternative), and alternatives to address areas with potential agent or UXO presence (the "A" and "U" alternatives, respectively).

19.2.1 Alternative 1/B1/A1/U1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), Alternative A1: No Additional Action (Provisions of FFA), and Alternative U1: No Additional Action (Provisions of FFA), applies to all 640,000 SY of exceedance area in the Section 36 Balance of Areas Subgroup. The 390,000 BCY of human health and biota volume, along with potential agent and potential UXO, remain in place. No action is taken to reduce potential human or biota exposure to COCs, to prevent potential physical and acute chemical hazards from agent and UXO, or to reduce groundwater contamination from this site. This alternative complies with the provisions of the FFA. Exceedance areas are monitored (an average of 71 samples per year over the entire exceedance area) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 19.2-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved and the potential impacts on groundwater are not reduced under this alternative as untreated soils remain in place without controls being initiated. Natural attenuation is ongoing, but the estimated time frame to achieve PRGs is more than 30 years. The residual risk is moderate due to the moderate levels of contamination in the soils. The poor-quality habitat at the site is not changed. The implementation of this alternative does not limit the range of alternatives, developed for the structures in site CSA-2a which vary from no action to demolition and removal of the resulting debris. The total estimated present worth cost of this alternative is $4,300,000. Table B4.22-1 details the costing for this alternative.

19.2.2 Alternative 2/B2/A1/U1: Institutional Controls

Alternative 2: Access Restrictions (Modifications to FFA), along with Alternative B2: Biota Management (Exclusion, Habitat Modification), Alternative A1: No Additional Action (Provisions of FFA), and Alternative U1: No Additional Action (Provisions of FFA), applies to the total exceedance area of 640,000 SY in the Section 36 Balance of Areas Subgroup. The

390,000 BCY of human health and biota volumes, along with potential agent and potential UXO, remain in place, but exposure pathways are interrupted. Human and biota access to the sites are restricted by the installation of a 11,000-ft perimeter of chain-link fence with warning signs. To prevent inadvertent exposures, the importance of maintaining and respecting access restrictions is presented in an ongoing public education program. In addition, biota exclusion is promoted by revegetating exceedance areas with grasses unappealing to biota, reducing the value of the habitat. Revegetation of 640,000 SY is accomplished over a 3-year period. Long-term activities include maintaining fences, mowing and spot herbiciding revegetated areas, and monitoring for erosion and vegetation damage. No actions are taken to reduce groundwater contamination from sites in this group. No action is taken to address potential agent/UXO exceedances. Exceedance areas are monitored (an average of 71 samples per year over the entire exceedance area) and 5-year site reviews are conducted to review the effectiveness of the alternative and to assess natural attenuation/degradation and potential migration of contaminants.

Table 19.2-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs by interrupting exposure pathways, so there is a low residual risk of exposure, although the migration of contaminants to groundwater is not addressed. Long-term maintenance is required to ensure the effectiveness of the access controls. Natural attenuation of contamination is ongoing, and the physical hazards from agent and UXO are addressed solely through the access restrictions initiated for the human health exceedances. The implementation of this alternative does not limit the range of alternatives developed for the structures in CSA-2a, which range from no action to demolition and removal of the resulting debris. The 640,000 SY of habitat present in this subgroup is eliminated for biota by habitat modification. The total estimated present worth cost of this alternative is $4,800,000. Table B4.22-2 details the costing for this alternative.

19.2.3 Alternative 3/B3/A4/U4: Landfill

For the Section 36 Balance of Areas Subgroup, Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill), Alternative A4:

Incineration/Pyrolysis (Rotary Kiln), and Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration), consists of excavating 390,000 BCY of contaminated soils and placing them in an on-post landfill. Dewatering, conducted at the site to lower the groundwater table to facilitate excavation activities, is initiated 1 to 2 years prior to the start of excavation. Dewatering continues throughout the excavation period. The groundwater is removed at 1 gpm and pumped to the CERCLA Wastewater Treatment Plant.

The Section 36 Balance of Areas Subgroup consists of 89,000 SY of soils with potential agent presence and 210,000 SY of soils with potential UXO presence. Prior to excavation, the areas with potential UXO presence are cleared by geophysics. Identified UXO are excavated, packaged, and transported to an off-post Army facility for demilitarization. The approximately 70,000 BCY of metallic debris mixed with surface soils from the UXO clearance operation are landfilled along with the 390,000 BCY of contaminated soils.

Prior to excavation activities, the soils also are screened for the presence of agent with real-time field analytical monitoring equipment. Soil confirmed to contain agent is excavated and transported to the incinerator located in the northeast corner of Section 2 in South Plants and treated by rotary kiln incineration. (Section 4.4.4 discusses the details of incineration.) The rotary kiln incinerator has an operating temperature of 760°C, a soils residence time of 66 minutes, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the soils feed (3 BCY) is recovered in the scrubber blowdown, and is placed in the on-post hazardous waste landfill due to the high inorganic concentrations and salts. The treated soil is returned to the site and used as backfill material.

Construction of the first cell of the multiple cell landfill and associated facilities takes 1 year. Construction starts during year 2 to have the same completion date as the incinerator used for the agent-contaminated soil. (Section 4.6.6 discusses the details of landfills.) A final cover is placed over the landfill upon closure. The cover contains a biota barrier to restrict burrowing

animals and a leachate collection and treatment system to prevent the migration of leachate into the groundwater. The cover is revegetated with native grasses that limit erosion and percolation of surface water. The landfill area is secured with a fence around the perimeter.

The excavations are backfilled with borrow soils from the on-post borrow area and the treated soils from the incineration process. Topsoil is placed over the backfilled area and the entire area is then revegetated to improve the habitat at the site. The borrow area is also recontoured and revegetated to restore habitat. Since the entire volume of contaminated soils and debris (390,000 and 70,000 BCY, respectively) are excavated and landfilled, long-term maintenance and monitoring, i.e.,cover maintenance and leachate collection and treatment, is only required at the landfill.

Table 19.2-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves RAOs, including the protection of groundwater, since the contaminated soils are excavated and transferred to a containment cell or incinerated. The habitat is improved at the site after remediation and restored at the borrow area. The disposal of the 390,000 BCY of human health and biota volumes and the 70,000 BCY of debris requires approximately 3 years based on the 1-year construction time frame for the landfill cell and the 2-year construction time frame for the incinerator. Prior to excavation, the structures are demolished and the structural debris removed from the site. The total estimated present worth cost of this alternative is $31,000,000. Table B4.22-3 details the costing for this alternative.

19.2.4 Alternative 6/B5/A2/U2: Caps/Covers

Alternative 6: Caps/Covers (Clay/Soil Cap), combined with Alternative B5: Caps/Covers (Clay/Soil Cap), Alternative A2: Caps/Covers (Clay/Soil Cap), and Alternative U2: Caps/Covers (Clay/Soil Cap), addresses the containment of 640,000 SY of human health and biota exceedance volumes that include potential agent and potential UXO presence. Surface sweep is conducted with a metal detector to ensure UXO are not present in near surface soils prior to subgrade preparation. Before any cover materials are installed, the subgrade is compacted and the surface

is crowned with 530,000 BCY of grading fill to control surface-water runoff. The human health and biota exceedance areas are covered by a 2-ft layer of low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. The fill materials for the cap are excavated from the on-post borrow area and topsoil is obtained off post. The capping operations take less than 1 year to complete. Maintenance activities (mowing and replacing eroded soils) ensure the continued integrity of the soil cap.

Table 19.2-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through containment. The potential for migration of contaminants to groundwater is greatly reduced, although mobility reductions may be reversible if the cap degrades or leaks. Habitat is improved at the site after remediation, but remains restricted for burrowing animals. Long-term maintenance is required to ensure the integrity of the cap. The total estimated present worth cost of this alternative is $52,000,000. Table B4.22-6 details the costing for this alternative.

19.2.5 Alternative 6g/B5a/A4/U4: Caps/Covers with Consolidation

Alternative 6g: Caps/Covers (Clay/Soil Cap) with Consolidation, along with Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation, Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration), addresses the containment of 390,000 BCY of human health and biota exceedance soils through the consolidation and containment of contaminated soils in Basin A. The sites in the Section 36 Balance of Areas Subgroup are dewatered to facilitate the excavation processes. Dewatering is initiated 2 years prior to the start of excavation and continues throughout the excavation period. Groundwater is removed at 1 gpm and pumped to the CERCLA Wastewater Treatment Plant.

There are approximately 210,000 SY of soils with potential UXO presence. Prior to excavation the area is cleared by geophysics. Identified UXO is excavated and packaged for shipment to

an off-post Army facility for demilitarization. During the removal of UXO, 70,000 BCY of metallic debris mixed with surficial soils are also removed and placed in the on-post landfill.

Approximately 89,000 SY of the Section 36 Balance of Area Subgroup potentially contains agent. Prior to excavation, this area is screened for agent using real-time field analytical equipment. Potential agent soils are stockpiled and covered. If agent contamination is confirmed by the RMA laboratory, the agent-contaminated soils are excavated and treated by rotary kiln incineration. (Section 4.6 discusses the details of incineration.) The incinerator has an operating temperature of 760°C, a processing rate of 470 BCY/day, and a residence time of 66 minutes. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the soils feed (3 BCY) is recovered as particulates from the scrubber blowdown and is placed in the on-post hazardous waste landfill due to the high inorganic concentrations and salts. The treated soils are returned to the site and used as backfill material. Construction of the rotary kiln incinerator requires 2 years and treatment of the agent-contaminated soils requires 1 year.

All remaining contaminated soil (390,000 BCY) is excavated and transported to Basin A to be consolidated and capped. Basin A requires a large volume of fill to bring the basin to design grade for capping as described in Section 10.2.4. Consolidating 390,000 BCY of soils from the Section 36 Balance of Areas Subgroup over the more highly contaminated soil in Basin A helps meet this need for grading fill and reduces the amount of clean borrow material that would otherwise be moved into Basin A. Consolidation also minimizes the overall area requiring long-term maintenance at RMA since the Basin A cap is maintained whether or not soils from this subgroup are consolidated at the basin. The cover at Basin A provides a physical barrier to protect human and biota receptors from directly contacting human health and biota exceedance soils. This alternative is predicated on the selection of Alternative 6f for the Basin A Medium Group.

The site excavations are backfilled with clean borrow material from the on-post borrow area and treated soils from incineration. Backfilled areas are covered with topsoil obtained off post, and the areas are revegetated to improve the habitat. The borrow area is also regraded and revegetated to restore the habitat. No maintenance activities are required at the sites because all exceedance soils are removed. Maintenance operations in Basin A ensures the integrity of the clay/soil cap.

Table 19.2-5 presents the detail evaluation at this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs and PRGs through consolidation and containment of exceedance soils at Basin A and treatment of agent materials and UXO. The contaminant mobility to groundwater is reduced and exposure pathways are interrupted by this alternative. Maintenance is not necessary at the site; however, long-term monitoring is required at the landfill and in Basin A. Habitat is improved at the site and restored at the borrow area. This alternative achieves RAOs in 3 years, which includes the time frame required to construct the rotary kiln incinerator and the landfill. Prior to excavation, the structures in Site CSA-2a are demolished, and the structural debris is removed from the site. The total estimated present worth cost of this alternative is $22,000,000. Table B7.22-6g details the costing for this alternative.

19.2.6 Alternative 13a/B6/A4/U4: Direct Thermal Desorption

Alternative 13a: Direct Thermal Desorption (Direct Heating), combined with Alternative B6: Direct Thermal Desorption (Direct Heating), Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration), treats 390,000 BCY of contaminated soils from Section 36 Balance of Areas Subgroup. Dewatering, conducted at the site to lower the groundwater table and to facilitate excavation is initiated 1 to 2 years prior to the start of excavation and continues throughout the excavation period. The groundwater is removed at 1 gpm and pumped to the CERCLA Wastewater Treatment Plant.

Prior to excavation, 210,000 SY of soils with potential UXO presence are cleared by geophysics. The identified UXO is excavated, packaged, and transported to an existing off-post Army facility for demilitarization. The 70,000 BCY of metallic debris mixed with surficial soils are also excavated and placed in the on-post landfill. The 89,000 SY of soils with potential agent presence are screened prior to excavation with real-time field analytical equipment. The potential agent soils are stockpiled and covered. If agent contamination is confirmed by RMA laboratory analysis, the agent-contaminated soils are excavated and treated using a rotary kiln incinerator. (Section 4.4.4 discusses the details of incineration.) The incinerator operates at 760°C with a 66-minute soils residence time. The processing rate is 470 CY/day. (Section 4.6.26 discusses emission controls for off gases from incineration.) One percent of the solids feed (3 BCY) is recovered as particulates in the scrubber blowdown. The particulates, with high concentrations of inorganics and salts, are placed in the on-post hazardous waste landfill. Soils treated by incineration are returned to the site as backfill.

The 390,000 BCY of contaminated soils are excavated and treated by thermal desorption. (Section 4.6 discusses thermal desorption in detail.) Construction of the centralized thermal desorber takes approximately 1 year, and requires an additional year for testing. The thermal desorber has a soils processing rate of 1,700 BCY/day since saturated soils are anticipated for this subgroup. This unit operates with a discharge temperature of 300°C with a soils residence time of 50 minutes. When operating under these conditions, the thermal desorber volatilizes all of the mercury and some of the arsenic present in the contaminated soils so that solidification of the treated soil is not required. (Section 4.6.24 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the soils feed (3,900 BCY) is recovered from the scrubber blowdown as particulates. Due to the mercury and arsenic content, the particulates are placed in the on-post landfill. The treated soils are then returned to the site excavations as backfill. Since thermal desorption destroys the natural organic content in the soils, topsoil obtained off post is placed over the backfilled area of 640,000 SY. The area is revegetated with native grasses to restore the habitat.

Table 19.2-6 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health RAOs and Biota PRGs since all contaminated soils are treated to remove or destroy the exceedance COCs. The habitat is improved at the site following remediation, and the migration of contaminants to groundwater is reduced. The thermal desorption of 390,000 BCY of contaminated soils requires a total of 4 years; the construction and testing of the facility requires 2 years before the soils can be treated. Prior to excavation, the structures are demolished, and the structural debris is removed from the site. The total estimated present worth cost of this alternative is $83,000,000. Table B4.22-13a details the costing for this alternative.

19.2.7 Alternative 19a/B11b/A4/U4: In Situ Thermal Treatment

Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating), combined with Alternatives B11b: In Situ Thermal Treatment (Surface Soil Heating, RF/Microwave Heating), A4: Incineration/Pyrolysis (Rotary Kiln), and U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration), treats 390,000 BCY of human health and biota exceedances. Dewatering, conducted at the site to lower the groundwater table and facilitate the excavation process, is initiated 1 to 2 years prior to the start of excavation and continues throughout the excavation period. The groundwater is removed at 1 gpm and pumped to the CERCLA Wastewater Treatment Plant.

Prior to treatment, the 210,000 SY of soils with potential UXO presence is cleared by geophysics. The identified UXO is excavated, packaged, and transported to an existing off-post Army facility for demilitarization. The 70,000 BCY of metallic debris mixed with surficial soils are excavated and transported to the on-post landfill.

Approximately 89,000 SY of soils have the potential for agent presence. Monitoring is conducted prior to site treatment and the area is screened for agent using real-time field analytical equipment. If agent contamination is confirmed by the RMA laboratory, the agent-contaminated soils, anticipated to be approximately 270 BCY, are excavated and treated in a rotary kiln

incinerator. (Section 4.4.4 discusses the details of incineration.) The incinerator has an operating temperature of 760°C, a 66-minute soils residence time, and a processing rate of 470 BCY/day. (Section 4.6.26 discusses emission controls for off gases from thermal desorption.) Approximately 1 percent of the solids feed (3 BCY) is recovered as particulates from scrubber blowdown. The particulates, high in inorganics and salts, are placed in the on-post landfill. Treated soils are backfilled into the excavations.

RF and surface soil heating are similar technologies that raise the temperature of the soil to more than 250°C, mobilizing the organic contaminants. The mobilized contaminants are collected and treated in the off-gas treatment system as described in Sections 4.5.9 and 4.6.29. Two types of RF units—deep and shallow—are used for treatment of the human health organic exceedance volume of 150,000 BCY and for a portion of the biota exceedance volume of 240,000 BCY. The deep unit treats a block of soil with dimensions of 100 ft long by 48 ft wide by 10 ft deep while the shallow unit treats a block 100 ft long by 36 ft wide by 5 ft deep. The soil moisture content of Section 36 Balance of Areas is approximately 20 percent; therefore, the RF treatment rate for the deep and shallow units is 130 and 120 BCY/day, respectively.

The 520,000 SY of surficial soils with biota exceedances is treated by surface soil heating. One surface soil unit is required for Section 36 Balance of Areas Subgroup to treat soils at a rate of approximately 3.5 acres or 17,000 SY/year. The liquid sidestream from in situ heating, predominantly salts, is transported to the thermal desorption facility for treatment. A 6-inch layer of topsoil is placed over the treated human health and biota exceedance areas of 640,000 SY to provide a medium for vegetation. The treated area is then revegetated with native grasses.

Table 19.2-7 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. Surface soil and RF heating can theoretically achieve Human Health and Biota RAOs with low residual risk since all OCPs and most volatile metals can be driven from the soil by this form of in situ thermal desorption. However, the pilot-scale test of the RF technology at RMA failed to confirm the temperature distribution and OCP removal required for confident treatment

of soils to achieve PRGs. Based on the technology's DRE, Human Health PRGs are anticipated to be achieved, but residual levels are anticipated to be higher than the Biota PRGs. The treated areas are revegetated to improve habitat, but some biota risk remains due to the failure to achieve PRGs. The implementability of in situ surface soil and RF heating is also questionable since there is no commercial source for the equipment and the technique is as yet unproven at full scale. The treatment of 390,000 BCY of contaminated soils is feasible within a total of 22 years. The structures are demolished prior to treatment and the resulting debris is removed from the site. The total estimated present worth cost of this alternative is $240,000,000. Table B4.22-19a details the costing for this alternative.

19.3 SECTION 36 BALANCE OF AREAS SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Section 36 Balance of Areas Subgroup consists of 390,000 BCY of exceedance soils contaminated with OCPs, CLC2A, arsenic, and mercury. Although contamination histories for the sites are varied, all sites in this subgroup have the potential presence of agent and UXO. Approximately 7 percent of the samples show an OCP exceedance of the Human Health SEC and a total of 10 percent of the samples exceed the Biota SEC for OCPs. The human health risk is relatively low as the average concentrations in the human health exceedance volume is substantially less than the Human Health SEC. In the biota exceedance volume, the average concentrations of two OCPs (dieldrin and endrin) exceed the Biota SEC. There are no exceedances of the principal threat criteria in this subgroup, but one site does contribute to a groundwater contamination plume that is intercepted and treated by the Basin A Neck IRA.

The area within the subgroup has poor-quality habitat based on the vegetation present. Alternatives that disrupt habitat include revegetation and restoration following remediation, so no significant habitat impacts are expected, except for the institutional controls alternative which involves the removal of habitat.

Alternatives that involve excavation of human health exceedances require clearing the soils of UXO, screening the soils for agent, and providing health and safety protection for site workers during remedial activities. The degree of contamination in sites in this subgroup does not necessitate special measures for odor control or community protection during remediation.

In summary, this subgroup contains biota and relatively low-level human health exceedances. Agent and UXO are potentially present and one site in the subgroup is a source of groundwater contamination. In selecting the preferred alternative, the longer-term risks of UXO, agent, and the migration of contaminants left in place should be considered against the short-term risks of worker exposure to physical and acute chemical hazards during remedial activities.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs as contaminated soils that may contain agent and UXO remain in place without the initiation of controls or treatment. This alternative is eliminated from further consideration as the preferred alternative. The remaining five alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action-specific and location-specific ARARs for the DAA. The alternatives differ only in how they satisfy the five balancing criteria.

Alternative 19a: In Situ Thermal Treatment achieves RAOs through treatment, but does not sufficiently reduce concentrations to achieve PRGs for the 10^{-6} excess cancer risk, which is the point of departure for treatment. The residual concentrations following treatment are within the acceptable risk range (10^{-6} to 10^{-4} excess cancer risk), but the residual risk does not achieve Biota SEC. In addition, this technology is unproven and is unavailable at full scale. Alternative 2: Access Restrictions exhibits the lowest cost of the remaining alternatives ($4,800,000); however, 390,000 BCY of untreated soils, which may contain agent and UXO, remain in place. Moreover, this alternative excludes 640,000 SY from use as habitat. The other treatment alternative, Alternative 13a: Direct Thermal Desorption, exhibits a higher cost ($83,000,000) than the alternatives that use engineering controls, Alternative 3: Landfill and Alternative 6g:

Caps/Covers with Consolidation. Both of these alternatives involve the excavation and removal of all of the exceedance volume from the site, although the landfill alternative exhibits a slightly higher cost ($31,000,000) than the caps/covers alternative ($22,000,000).

The preferred alternative for the Section 36 Balance of Areas Subgroup is therefore Alternative 6g: Caps/Covers with Consolidation. This alternative is cost effective for this subgroup as contaminated soils are consolidated and contained at a location within 1 mile of the sites. The material excavated from this subgroup is used as part of the material required to regrade Basin A prior to capping. In addition, the alternative results in an overall cost reduction since long-term monitoring and maintenance are reduced through a decrease in the area that must be monitored at RMA. This alternative is consistent with NCP guidance on the use of engineering controls for lower levels of contamination.

The structures within site CSA-2a are demolished prior to treatment to allow access to the contaminated soils. In accordance with the alternatives evaluated for the No Future Use, Manufacturing History and No Future Use, Agent History Medium Groups, structural debris is removed from the site for treatment and/or containment. Dewatering is also required prior to excavation to allow the excavation of soils near the water table. The design of the dewatering system must be coordinated with the well locations for the preferred alternative for the Basin A Plume Group. Depending on the schedule for groundwater remediation, the need for a soils dewatering system may be reduced.

19.4 BURIAL TRENCHES SUBGROUP CHARACTERISTICS

The Burial Trenches Subgroup is composed of sites ESA-2a (Section 32 Burn Pits) and ESA-2c (Open Trenches) (Figure 19.0-1). These sites located in Sections 32 and 30 of the Eastern Study Area, may contain agent and HE-filled UXO based on the operations that occurred there. Site ESA-2a was not used for the detonation of agent-filled UXO and consequently is assumed to contain HE-filled UXO. Site ESA-2c potentially contains agent. The principal threat criteria

were not exceeded for any soils within this subgroup, and none of the sites within this subgroup are associated with groundwater plumes.

Table 19.4-1 provides a summary of contaminants, concentrations, and exceedance values for this subgroup. Table 19.4-2 summarizes the frequency of contaminant detections in the samples for this subgroup. The first table shows that maximum concentrations of chromium and lead exceed the Human Health SEC. Isolated detections of arsenic at 32 ppm exceed the Biota SEC. Figure 19.4-1 shows the distribution of exceedance areas for the Burial Trenches Subgroup, Table 19.0-1 lists the exceedance areas and volumes, and Figure 19.4-2 presents the overlap of these exceedance areas with those with potential agent and UXO presence. Several of the individual burn pits in ESA-2a potentially contain HE-filled UXO, but do not contain either human health or biota exceedances.

The sites within the Burial Trenches Subgroup contain moderate-quality habitat based on the types of vegetation encountered. Some of the sites are contained within prairie dog colonies, which are considered high-quality habitat. The overall habitat value is improved through remedial actions since the areas that are disturbed are revegetated with native grasses, although alternatives involving containment with a cap/cover require the exclusion of burrowing animals. Since this area is located within the Bald Eagle Management Area, the evaluation of alternatives for this subgroup considers the impacts of alternatives on the habitat within these sites.

19.5 BURIAL TRENCHES SUBGROUP EVALUATION OF ALTERNATIVES

The five alternatives for the Burial Trenches Subgroup vary in approach from no action to treatment. An alternative involving containment (Alternative 6) was added to contain areas with low levels of contamination and potential HE-filled UXO presence; however, Alternative 13 was removed from consideration due to the absence of any organic exceedances. The following subsections present a description of each alternative and an evaluation of the alternative against the EPA criteria for the DAA. The alternatives for this subgroup consist of an alternative to address human health exceedance areas (which is listed first), an alternative to address biota

exceedance areas (the "B" alternative), and alternatives to address areas with potential agent, and UXO presence (the "A" and "U" alternatives, respectively).

19.5.1 Alternative 1/B1/A1/U1: No Additional Action

Alternative 1: No Additional Action (Provisions of FFA), along with Alternative B1: No Additional Action (Provisions of FFA), Alternative A1: No Additional Action (Provisions of FFA), and Alternative U1: No Additional Action (Provisions of FFA), applies to all 43,000 SY of exceedance area in the Burial Trenches Subgroup. The 31,000 BCY of human health and biota exceedances that include potential HE-filled UXO and agent remain in place. This alternative complies with the provisions of the FFA. No action is taken to reduce potential human or biota exposure to COCs or to physical or acute chemical hazards. Exceedance areas are monitored (an average of 12 samples per year) and 5-year site reviews are conducted to assess natural attenuation/degradation and potential migration of contaminants.

Table 19.5-1 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. Human Health and Biota RAOs are not achieved under this alternative as untreated soils and potential agent and UXO presence remain in place without controls being initiated, but the residual risk is low due to the low levels of contamination. Natural attenuation of untreated soils is ongoing, but the estimated time frame for achieving PRGs is more than 30 years. The quality of habitat at the sites is not changed. The total present worth cost of the alternative is $900,000. Table B4.23-1 details the costing for this alternative.

19.5.2 Alternative 3/B3/A4/U4a: Landfill

For the Burial Trenches Subgroup, Alternative 3: Landfill (On-Post Landfill), combined with Alternative B3: Landfill (On-Post Landfill), Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4a: Detonation (Off-Post Army Facility), addresses 31,000 BCY of contaminated soils. These contaminated soils are excavated and placed in an on-post landfill.

The Burial Trenches Subgroup contains 170,000 SY of soils with potential HE-filled UXO presence. Prior to excavation, the areas with potential UXO presence are cleared by geophysics. The UXO is excavated, packaged, and transported to an Army off-post facility for treatment. Approximately 57,000 BCY of metallic debris mixed with surficial soils are excavated and placed in the on-post landfill along with the 31,000 BCY of contaminated soils.

The Burial Trenches Subgroup also contains 7,100 SY of soils with potential agent presence that are screened prior to excavation with real-time field analytical equipment. The soils identified as contaminated with agent are stockpiled and covered until they undergo laboratory analysis. If the presence of agent is confirmed by the RMA laboratory, the soils are excavated and treated using a rotary kiln incinerator. (Section 4.4.4 discusses the details of incineration.) The incinerator operates at 760°C with a 66-minute residence time and a processing rate of 470 BCY/day. (Section 4.6.26 describes emission controls for off gases from incineration.) One percent of the soils feed (less than 1 BCY) is recovered in the scrubber blowdown as particulates based on 12 BCY of soils containing agent. Due to the high inorganic concentrations and salts, the particulates are placed in the on-post hazardous waste landfill. Treated soils are backfilled into the excavations.

Construction of the first cell of the multiple cell landfill and associated facilities takes 1 year and starts during year 2 so that the completion date is the same as that for the incinerator. (Section 4.6.6 which discusses landfills in detail.) A final cover is placed over the landfill upon closure. The cover, which contains a biota barrier to restrict burrowing animals and a leachate collection and treatment system to stem the migration of leachate into the groundwater is vegetated to limit erosion and percolation of surface water. The perimeter of the landfill area is secured with a fence.

The excavations are backfilled with borrow soils taken from the on-post borrow area. Topsoil obtained off post is placed in the backfilled area and is revegetated to improve the habitat at the site. The borrow area is also recontoured and revegetated to restore habitat. Since 31,000 BCY

of untreated soils and 57,000 BCY of debris are contained in the landfill, long-term leachate collection and treatment and cover maintenance are required.

Table 19.5-2 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. Since the contaminated soils are excavated and transferred to a containment cell or incinerated, the RAOs are achieved for this alternative. The habitat is improved at the site and restored at the borrow area. The disposal of the 31,000 BCY of human health and biota volumes and the 57,000 BCY of debris takes approximately 3 years, including the 1-year construction time frame for the landfill cell and the 2-year construction time frame for the incinerator. The total estimated present worth cost of this alternative is $5,900,000. Table B4.23-3 details the costing for this alternative.

19.5.3 Alternative 6/B5/A2/U2: Caps/Covers

Alternative 6: Caps/Covers (Clay/Soil Cap), combined with Alternative B5: Caps/Covers (Clay/Soil Cap), Alternative A2: Caps/Covers (Clay/Soil Cap), and Alternative U2: Caps/Covers (Clay/Soil Cap), addresses the containment of 43,000 SY of human health and biota exceedance area that also includes agent and potential HE-filled UXO presence. A surface sweep is conducted with a metal detector to ensure UXO are not present in near surface soils prior to preparation of the subgrade. The subgrade is compacted, before any cover materials are installed, and the surface is crowned with grading fill to control surface-water runoff. The human health and biota areas are covered by a 2-ft layer of low-permeability soil, a 1-ft biota barrier of cobbles, and a 4-ft soil/vegetation layer that includes 6 inches of topsoil. The areas with potential agent and UXO presence that are outside the human health and biota exceedance areas and are covered with a 1.5-ft layer of general fill and 6 inches of topsoil. The cover provides a physical barrier to protect human and biota receptors from directly contacting soils with potential HE-filled UXO or agent. These areas are then revegetated to restore the habitat. The fill materials for the cap are excavated from the on-post borrow area, and topsoil is obtained off post. The capping operations take less than 1 year to complete. Maintenance activities (mowing and replacing eroded soils) ensure the continued integrity of the soil cap.

Table 19.5-3 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs through containment. The potential for migration of contaminants to groundwater and surface water is greatly reduced, although mobility reductions may be reversible if the cap degrades or leaks. Habitat is improved at the site after remediation, but remains restricted for burrowing animals. Long-term maintenance is required to ensure the integrity of the cap. The total estimated present worth cost of this alternative is $5,700,000. Table B4.23-6 details the costing for this alternative.

19.5.4 Alternative 10/B3/A4/U4a: Direct Solidification/Stabilization

Alternative 10: Direct Solidification/Stabilization (Cement-Based Solidification), combined with Alternative B3: Landfill (On-Post Landfill), Alternative A4: Incineration/Pyrolysis (Rotary Kiln), and Alternative U4a: Detonation (Off-Post Army Facility), treats 31,000 BCY of exceedance soils by cement-based solidification.

Prior to excavation, 170,000 SY are cleared for UXO by using geophysical surveys. Identified UXO is excavated, packaged, and shipped off post for demilitarization. The 57,000 BCY of metallic debris mixed with surficial soils are is excavated and placed in the on-post landfill.

Prior to excavation, 7,100 SY that potentially contain agent are screened with real-time field analytical equipment. The soils identified as contaminated with agent are stockpiled and covered until they undergo laboratory analysis. If agent presence is confirmed by the RMA laboratory, the soils are excavated and treated by rotary kiln incineration. (Section 4.4.4 discusses the details of incineration.) The incinerator operates at 760°C with a 66-minute residence time and a processing rate of 470 BCY/day. The incinerator takes 1 year to construct and 1 year to test. (Section 4.6.26 discusses emission controls for off gases from incineration.) Approximately 1 percent of the soils feed (1 BCY) are recovered in the scrubber blowdown and are placed in the on-post hazardous waste landfill.

The 31,000 BCY of soils with inorganic exceedances are excavated and solidified using a portable pug mill capable of treating 46 BCY/day. The contaminated soils are treated by adding cement as a binder at a 20 percent ratio to immobilize ICP metals in the soils. During excavation and solidification, the volume of contaminated soils increases by 20 percent, which results in a total volume of 37,000 CY. The solidified soils are placed in the site excavations and covered with borrow material from the on-post borrow area. The solidified soils require a soil cover of at least 4 ft to ensure the integrity of the solidified materials and to prevent freeze/thaw degradation of the materials. The cover is revegetated, thereby improving habitat quality, and the borrow area is revegetated to restore habitat. In all, 43,000 SY of backfilled area is revegetated with natural grasses.

The 57,000 BCY of UXO debris are landfilled. Construction of the first cell of the multiple cell landfill and associated facilities takes 1 year and starts during year 2 so that the completion time is the same as that for the incinerator. (Section 4.6 discusses landfills in detail.) After placement of contaminated materials, the landfill is covered, revegetated, and secured with a fence. A leachate collection and treatment system is operated to protect groundwater.

The excavations are backfilled with borrow soils taken from the on-post borrow area. Topsoil obtained off post is placed over the backfilled area and is revegetated to improve the habitat at the site. The borrow area is also revegetated to restore habitat. Long-term monitoring and maintenance of the landfill cell is required to ensure the integrity of the cover and the leachate collection and treatment system.

Table 19.5-4 presents the detailed evaluation of this alternative against the EPA criteria for the DAA. This alternative achieves Human Health and Biota RAOs since all contaminated soils are removed from the site and either treated or landfilled. The potential physical and acute chemical hazards from agent and UXO are addressed through removal and treatment or demilitarization. The habitat is improved at the site and at the on-post borrow area. The solidification of 31,000 BCY of soils takes 5 years, including 2 years for construction and testing of the facilities. The

total estimated present worth cost of this alternative is $10,000,000. Table B4.23-10 details the costing for this alternative.

19.6 BURIAL TRENCHES SUBGROUP SELECTION OF PREFERRED ALTERNATIVE

The Burial Trenches Subgroup contains 31,000 BCY of exceedance volume that includes metals and arsenic contamination. Approximately 3 percent of the samples exceed the Human Health SEC for lead and 1 percent of the samples exceed the Biota SEC for arsenic. The human health risk is relatively low as the average concentrations of COCs in the human health exceedance volume are well below the Human Health SEC. The average concentration of arsenic in the biota exceedance volume is above the Biota SEC. These sites may contain agent and HE-filled UXO based on site histories. Principal threat criteria are not exceeded by any contaminants, and none of the sites are associated with groundwater contamination.

This subgroup provides moderate-quality habitat based on the vegetation types present, and includes areas within prairie dog colonies and the Bald Eagle Management Area, so the selection of the preferred alternative must consider the impacts of remediation on habitat. Areas disturbed during remediation are to be revegetated to restore and improve habitat value, although alternatives involving a cap/cover for containment require exclusion of burrowing animals.

Excavation of soils in the Burial Trenches Subgroup requires clearing the soils of UXO, screening the soils for agent, and providing health and safety protection for site workers. The degree of contamination does not necessitate special measures for odor control or community protection during excavation, and the short-tern risk to workers is minimal with the use of proper health and safety equipment and procedures.

In summary, this subgroup contains low-level human health and biota exceedances along with the potential presence of agent and HE-filled UXO. Factors to be considered in selecting the preferred alternative for the subgroup include the restoration of the moderate-quality habitat

following remediation and an assessment of short-term risks to workers from excavation activities against the longer-term risk of leaving exceedances in place.

Alternative 1: No Additional Action does not achieve Human Health or Biota RAOs since untreated soil that potentially contains HE-filled UXO and agent remain in place without controls or treatment being initiated. This alternative is eliminated from further consideration as the preferred alternative. The remaining four alternatives achieve RAOs and meet the two DAA threshold criteria: protection of human health and the environment and compliance with action-specific and location-specific ARARs for the DAA. The alternatives differ only in how they satisfy the five balancing criteria (Tables 19.5-1 through 19.5-5).

All four of the remaining alternatives use adequate and reliable engineering controls or treatment methods and are readily implemented. Alternative 10: Direct Solidification/Stabilization exhibits the highest cost of the remaining alternatives ($10,000,000) but requires the separation of debris from the burn trenches prior to treatment. Alternative 3: Landfill excavates and removes the contaminants from the site and addresses the disposal of 31,000 BCY of contaminated soils and 57,000 BCY of soils mixed with debris. These two alternatives result in the improvement of more than 43,000 SY of habitat following the removal of debris and contaminated soils. Alternative 6: Caps/Covers (Clay/Soil Cap) contains the contaminated soils in place and limits the use of the 43,000 SY as habitat since burrowing animals are excluded from the capped area. Alternative 3: Landfill consolidates the soils and debris into a landfill, thereby reducing the areas requiring long-term monitoring and maintenance as compared to Alternative 6: Caps/Covers, which requires long-term maintenance for 43,000 SY.

The preferred alternative for the Buried Trenches Subgroup is Alternative 3: Landfill. Since the area to be remediated has only low levels of contamination and large amounts of debris, this containment alternative is cost effective. Alternative 6: Caps/Covers exhibits a similar cost, but requires the management of 43,000 SY of capped soils in various portions of the Eastern Study Area and restricts its use as habitat for burrowing animals. The selection of Alternative 3:

Landfill is consistent with NCP guidance on the use of engineering controls for low levels of contamination.

Table 19.0-1 Characteristics of the Undifferentiated Medium Group

Characteristic	Section 36 Balance of Areas Subgroup	Burial Trenches Subgroup
<u>Contaminants of Concern</u>		
Human Health	OCPs, CLC2A, As, Hg	ICP metals
Biota	OCPs, Hg	As
<u>Exceedance Area (SY)</u>		
Total	640,000	43,000
Human Health	120,000	43,000
Biota	520,000	80
Potential Agent	89,000	7,100
Potential UXO	210,000	170,000
<u>Exceedance Volume (BCY)</u>		
Total	390,000	31,000
Human Health	150,000	31,000
Organic	150,000	0
Inorganic	0	31,000
Principal Threat	0	0
Biota OCPs	240,000	130
Potential Agent	270	12
Potential UXO	140	550
<u>Depth of Contamination (ft)</u>		
Human Health	0–10	0–10
Biota	0–5	0–5

[1] Based on concentrations of contaminants of concern above SEC exceedance volume

BCY Bank Cubic Yard;
UXO Unexploded Ordnance
OCP Organochlorine Pesticide
SY Square Yard

ft Feet
As Arsenic
Hg Mercury
CLC2A Chloroacetic Acid

ICP Inductively Coupled Plasma
– Not Applicable

Table 19.1-1 Summary of Concentrations for the Section 36 Balance of Areas Subgroup

Contaminants of Concern	Range of Concentrations[1] (ppm)	Average Concentration[1] (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Aldrin	BCRL–160	3.9	56	560	0.68
Dieldrin	BCRL–190	7.2	40	400	0.83
Endrin	BCRL–61	2.0	15	15,000	0.029
Isodrin	BCRL–27	0.65	3.4	3,400	not applicable
Chlordane	BCRL–110	6.3	3.1	260	not applicable
CLC2A	BCRL–310	110	74	74,000	not applicable
p,p,DDE	BCRL–1.4	0.05	130	1,300	0.2
p,p,DDT	BCRL–19	0.19	26	1,300	1.4
Arsenic	BCRL–31	3.3	530	5,300	16.5
Mercury	BCRL–56	0.97	470	470,000	0.99
Biota Exceedance Volume					
Aldrin	BCRL–16	0.67	56	560	0.68
Dieldrin	BCRL–31	3.2	40	400	0.83
Endrin	BCRL–6.0	0.32	15	15,000	0.029
p,p,DDE	BCRL–0.22	0.007	130	1,300	0.2
p,p,DDT	BCRL–2.8	0.020	26	1,300	1.4
Arsenic	BCRL–18	2.0	530	5,300	16.5
Mercury	BCRL–136	2.1	470	470,000	0.99

1 Based on modeled concentrations within exceedance volume.

Table 19.1-2 Frequency of Detections for Section 36 Balance of Areas Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	289	247	85.5%	28	9.7%	13	4.5%	1	0.3%	0	0.0%
Benzene	51	45	88.2%	6	11.8%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	51	51	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	289	255	88.2%	26	9.0%	--	--	8	2.8%	0	0.0%
Chloroacetic Acid	14	13	92.9%	0	0.0%	--	--	1	7.1%	0	0.0%
Chlorobenzene	51	51	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	51	46	90.2%	5	9.8%	--	--	0	0.0%	0	0.0%
p,p,DDE	289	265	91.7%	21	7.3%	3	1.0%	0	0.0%	0	0.0%
p,p,DDT	289	270	93.4%	18	6.2%	0	0.0%	1	0.3%	0	0.0%
Dibromochloropropane	265	247	93.2%	18	6.8%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	51	51	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	17	.17	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	235	234	99.6%	1	0.4%	--	--	0	0.0%	0	0.0%
Dieldrin	289	210	72.7%	54	18.7%	21	7.3%	4	1.4%	0	0.0%
Endrin	289	244	84.4%	13	4.5%	30	10.4%	2	0.7%	0	0.0%
Hexachlorocyclopentadiene	289	277	95.8%	9	3.1%	--	--	0	0.0%	0	0.0%
Isodrin	289	266	92.0%	21	7.3%	--	--	2	0.7%	0	0.0%
Methylene Chloride	47	32	68.1%	15	31.9%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	51	51	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Toluene	51	50	98.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	51	51	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	248	186	75.0%	60	24.2%	2	0.8%	0	0.0%	0	0.0%
Cadmium	213	200	93.9%	13	6.1%	--	--	0	0.0%	0	0.0%
Chromium	213	53	24.9%	160	75.1%	--	--	0	0.0%	0	0.0%
Lead	212	164	77.4%	48	22.6%	--	--	0	0.0%	0	0.0%
Mercury	283	219	77.4%	59	20.8%	5	1.8%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 19.2-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Addition Action (Provisions of FFA) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants due to natural attenuation; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site review achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Balance of Areas Subgroup not located wetlands in 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Moderate residual risk. OCPs, CLC2A, arsenic, and mercury above Human Health SEC and OCPs and mercury above Biota SEC remain in soils and may impact human health and biota; potential presence of agent/UXO remains.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews and groundwater monitoring required.
c) Habitat impacts	c) Habitat quality not improved. Existing poor-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume of mobility except by natural attenuation; 390,000 BCY of untreated soils remain; no reduction in hazards for agent or UXO presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing poor-quality habitat not impacted by remedial alternative; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contaminant reduction; soils with potential agent and UXO remain on site.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $4,300,000
d) Total	d) $4,300,000

Table 19.2-2 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative B2: Biota Management (Exclusion, Habitat Modification); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. RAOs achieved as human and biota exposure pathways interrupted through access restrictions and biota controls; groundwater impacts not reduced.
2. Compliance with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as access adequately controlled and site reviews conducted; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Balance of Areas Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. OCPs, CLC2A, As, and Hg above Human Health SEC and OCPs and mercury above Biota SEC remain in soil; fencing, land-use restrictions, and cultivation of lower-quality habitat reduces potential human and biota exposure; potential presence of agent/UXO remains.
b) Adequacy and reliability of controls	b) Adequate controls. Installation of fencing, land-use restrictions, and biota controls reduce exposure; controls adequate for small area; long-term maintenance, site reviews, groundwater monitoring, and monitoring of wildlife exclusion required.
c) Habitat impacts	c) Habitat quality eliminated. Biota controls of fencing and cultivation of lower-quality habitat eliminate habitat for biota.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction of contaminant volume or mobility except by natural attenuation for 390,000 BCY of untreated soils; human and biota exposure pathways interrupted over 640,000 SY by land-use restrictions, fencing, and biota controls; no reduction in hazards for agent or UXO presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Exposure controls reversible if fencing or biota controls fail.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative. Contaminants remain in place with highest levels of contamination at depth.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during fence installation and cultivation of lower-quality habitat.
b) Protection of community during remedial action	b) Protective of community. Dust and vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater not reduced.
d) Time until RAOs are achieved	d) 3 years. Installation of perimeter fencing within several months but cultivation of lower-quality habitat requires 3 years; natural attenuation of untreated soils ongoing; soils with potential agent and UXO remain on site.

Table 19.2-2 Evaluation of Alternative 2: Access Restrictions (Modifications to FFA); Alternative B2: Biota Management (Exclusion, Habitat Modification); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; additional remedial actions easily undertaken for soils left in place.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment readily available for fence installation and habitat modifications.
7. Present worth costs	
a) Capital	a) $360,000
b) Operating	b) $230,000
c) Long-term	c) $4,200,000
d) Total	d) $4,800,000

Table 19.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-11, A-16, and A-17)	a) Complies with action-specific ARARs including state regulations on landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Balance of Areas Subgroup, incinerator, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 390,000 BCY of untreated soil contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site, but eliminates poor-quality habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) Exposure pathways interrupted and mobility of contaminants reduced through containment of 390,000 BCY in on-post landfill; soils with agent and UXO identified and treated.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) Groundwater removed from dewatering system at 1 gpm and pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, dewatering, excavation, and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact on biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Excavation of 390,000 BCY within 1 year after 2 years for construction of landfill and incinerator for agent treatment.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; dewatering required; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.

Table 19.2-3 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $9,600,000
b) Operating	b) $20,000,000
c) Long-term	c) $1,700,000
d) Total	d) $31,000,000

Table 19.2-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap); Alternative U2: Caps/Covers (Clay/Soil Cap) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health and Biota SEC covered by clay/soil cap, biota barrier, and vegetative layer, preventing exposure; groundwater impacts reduced.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-5)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Balance of Areas Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA but does not achieve Army regulations (AMC-R 385-131) regarding agent or UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 390,000 BCY of untreated soils contained through installation of 640,000-SY clay/soil cap with biota barrier.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover maintenance required; high confidence in engineering controls of clay/soil cap.
c) Habitat improved	c) Habitat quality improved. Revegetation of cap with native grasses improves habitat quality. Restrictions to burrowing animals help preserve integrity of cap and to prevent exposure.
4. Reduction in TMV through treatment	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 640,000-SY clay/soil cap; soils with agent/UXO contained with clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap/cover degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance and installation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing moderate-quality habitat.
d) Time until RAOs are achieved	d) 2 years. Installation of 640,000-SY clay/soil cap feasible within 2 years; natural attenuation of untreated soils ongoing.

Table 19.2-4 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap); Alternative U2: Caps/Covers (Clay/Soil Cap) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment and specialists readily available for cap/cover construction; clay/soil caps well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $36,000,000
c) Long-term	c) $16,000.000
d) Total	d) $52,000,000

Table 19.2-5 Evaluation of Alternative 6g: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health and Biota SEC excavated and consolidated in Basin A for containment with clay/soil cap, preventing exposure; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-5, A-8, A-9, A-11, A-16, and A-17)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Balance of Areas Subgroup and Basin A not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 390,000 BCY of soils consolidated and contained in Basin A by clay/soil cap.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for Basin A; high confidence in engineering controls of clay/soil cap in Basin A.
c) Habitat improved	c) Habitat quality restored. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through consolidation for 390,000 BCY of contaminated soils in Basin A and installation of clay/soil cap in Basin A; soils with agent/UXO identified and treated.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if Basin A cap degrades or leaks.
d) Type and quantity of treatment residuals	d) Groundwater removed at 1 gpm by dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, dewatering, excavation, and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants of groundwater reduced.
d) Time until RAOs are achieved	d) 3 years. Consolidation of 390,000 BCY in Basin A feasible within 1 year after 2 years for construction of incinerator for agent treatment.

Table 19.2-5 Evaluation of Alternative 6g: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation; Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative implemented within required time frame and reliably maintained thereafter; cap/cover monitored; dewatering required; additional remedial actions would require removal of cap/cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Equipment and specialists readily available for consolidation and clay/soil cap construction; clay/soil caps well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $2,000,000
b) Operating	b) $20,000,000
c) Long-term	c) $260,000
d) Total	d) $22,000,000

Table 19.2-6 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment; contaminated soils treated to organic detection levels and inorganics reduced below Biota SEC; blowdown solids placed in on-post landfill; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-10, A-11, A-16, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources and landfill siting, design, and operation; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Balance of Areas Subgroup, thermal desorption facility, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provision of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs. 390,000 BCY thermally desorbed and returned to site as backfill; approximately 1% of soils feed recovered from off-gas treatment equipment placed in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Backfill monitoring not required; no difficulties associated with landfill maintenance; high confidence in engineering controls associated with landfill.
c) Habitat impacts	c) Habitat quality improved. Revegetation of disturbed areas improves existing poor-quality habitat, offsetting loss during excavation.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 390,000 BCY thermally desorbed to degrade OCPs and CLC2A and remove mercury; soils with agent and UXO identified and treated.
b) Degree and quantity of TMV reduction	b) Organics reduced below detection levels (>99.99% destruction removal efficiency); TMV of organics eliminated; mercury removed below Biota SEC; arsenic reduced below Human Health SEC following solids blending as a pretreatment and limited volatilization during thermal desorption (20 to 30%); scrubber blowdown solids from off-gas treatment equipment with arsenic, mercury, and salts contained in on-post landfill.
c) Irreversibility of TMV reduction	c) TMV reduction by thermal desorption irreversible.
d) Type and quantity of treatment residuals	d) 3,900 BCY of blowdown solids with arsenic, mercury, and salts landfilled; groundwater removed at 1 gpm by dewatering system pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, dewatering, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dusts controlled by water spraying; vapor emissions not anticipated from excavation; vapor emissions associated with thermal desorber controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 4 years. Excavation and treatment of 390,000 BCY feasible within 2 years after 2 years for construction of thermal desorption facility, incinerator for agent treatment, and landfill.

Table 19.2-6 Evaluation of Alternative 13a: Direct Thermal Desorption (Direct Heating); Alternative B6: Direct Thermal Desorption (Direct Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cell monitored; dewatering required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system and landfill siting, and operating regulations.
c) Availability of services and materials	c) Readily available. Several vendor sources available for design and construction of thermal desorbers; equipment, specialists, and materials readily available for construction of landfill; thermal desorbers and landfills well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $14,000,000
b) Operating	b) $69,000,000
c) Long-term	c) $280,000
d) Total	d) $83,000,000

Table 19.2-7 Evaluation of Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative B11b: In Situ Thermal Treatment (Surface Soil Heating, RF/Microwave Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment, but Biota PRGs not achieved; groundwater impacts reduced.
2. Compliance with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-11, A-13, A-16, and A-17)	a) Complies with action-specific ARARs including state regulations on air emissions sources; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Section 36 Balance of Areas Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk within acceptable range. 390,000 BCY thermally treated in place but Biota PRGs not achieved.
b) Adequacy and reliability of controls	b) Controls not required. Monitoring of treated soil not required.
c) Habitat improved	c) Habitat quality improved. Revegetation of disturbed area improves existing poor-quality habitat, but some biota risk remains as Biota PRGs not achieved.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) 390,000 BCY thermally treated to degrade OCPs and CLC2A and remove mercury; soils with agent/UXO identified and treated.
b) Degree and quantity of TMV reduction	b) Reductions from RF heating (>97-99.9% destruction removal efficiency) unable to achieve biota PRGs; TMV of OCPs reduced during RF treatment to achieve Human Health PRGs; mercury and arsenic condensed in blow down liquid.
c) Irreversibility of TMV reduction	c) TMV reduction by in situ RF heating irreversible.
d) Type and quantity of treatment residuals	d) Liquid blowdown sidestream with mercury, arsenic, and salts treated at thermal desorption facility with scrubber effluent. Groundwater removed at 1 gpm from dewatering system and pumped to CERCLA Wastewater Treatment Plant.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, dewatering, and in situ heating.
b) Protection of community during remedial action	b) Protective of community. No fugitive dust emissions; vapor emissions associated with RF heating unit controlled by air emission control equipment.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing poor-quality habitat; migration of contaminants to groundwater reduced.
d) Time until RAOs are achieved	d) 22 years. RF heating of 390,000 BCY feasible within 22 years.

Table 19.2-7 Evaluation of Alternative 19a: In Situ Thermal Treatment (RF/Microwave Heating); Alternative B11b: In Situ Thermal Treatment (Surface Soil Heating, RF/Microwave Heating); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4: Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) for the Section 36 Balance of Areas Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Potentially technically feasible. Pilot-scale testing of RF heating on soil with similar contaminants but unproven at full scale; additional remedial actions easily undertaken for treated soils that do not achieve PRGs; dewatering required.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of treatment system siting, design and operating regulations.
c) Availability of services and materials	c) Limited availability. Equipment custom designed for each application and not available; specialists only available through process licensor IITRI; no full scale demonstration of RF equipment.
7. Present worth costs	
a) Capital	a) $37,000,000
b) Operating	b) $200,000,000
c) Long-term	c) $260,000
d) Total	d) $240,000,000

Table 19.4-1 Summary of Concentrations for the Burial Trenches Subgroup

Contaminants of Concern	Range of Concentrations (ppm)	Average Concentration (ppm)	Human Health SEC (ppm)	Principal Threat Criteria (ppm)	Biota SEC (ppm)
Human Health Exceedance Volume					
Chromium	BCRL-33	20	40	10,000	not applicable
Lead	BCRL-3,400	260	1,900	not applicable	not applicable
Biota Exceedance Volume					
Arsenic[1]	32	32	530	5,300	16.5

1 Reported as isolated exceedance.

Table 19.4-2 Frequency of Detections for Burial Trenches Subgroup

	Total Samples	BCRL		CRL-SEC(1)		Biota SEC-HH SEC(2)		HH SEC-Pr. Threat(2)		>Pr. Threat(2)	
	Analyzed	Number	%	Number	%	Number	%	Number	%	Number	%
Aldrin	80	76	95.0%	4	5.0%	0	0.0%	0	0.0%	0	0.0%
Benzene	32	29	90.6%	3	9.4%	--	--	0	0.0%	0	0.0%
Carbon Tetrachloride	34	34	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlordane	80	80	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroacetic Acid	33	33	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chlorobenzene	34	34	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Chloroform	34	33	97.1%	1	2.9%	--	--	0	0.0%	0	0.0%
p,p,DDE	80	80	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
p,p,DDT	80	80	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Dibromochloropropane	73	73	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,2-Dichloroethane	34	34	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
1,1-Dichloroethene	16	16	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dicyclopentadiene	67	67	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Dieldrin	80	72	90.0%	8	10.0%	0	0.0%	0	0.0%	0	0.0%
Endrin	80	78	97.5%	2	2.5%	0	0.0%	0	0.0%	0	0.0%
Hexachlorocyclopentadiene	80	80	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Isodrin	80	79	98.8%	1	1.3%	--	--	0	0.0%	0	0.0%
Methylene Chloride	27	27	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethane	1	1	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Tetrachloroethylene	34	33	97.1%	1	2.9%	--	--	0	0.0%	0	0.0%
Toluene	32	32	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Trichloroethylene	34	34	100.0%	0	0.0%	--	--	0	0.0%	0	0.0%
Arsenic	82	50	61.0%	31	37.8%	1	1.2%	0	0.0%	0	0.0%
Cadmium	87	70	80.5%	17	19.5%	--	--	0	0.0%	0	0.0%
Chromium	87	10	11.5%	77	88.5%	--	--	0	0.0%	0	0.0%
Lead	87	49	56.3%	35	40.2%	--	--	3	3.4%	0	0.0%
Mercury	62	62	100.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%

(1) SEC limit for this interval is Biota SEC for compounds with Biota criteria and HH SEC for remaining compounds.
(2) Table 1.4-1 presents Biota SEC, HH SEC, and Principal Threat Criteria.

Table 19.5-1 Evaluation of Alternative 1: No Additional Action (Provisions of FFA); Alternative B1: No Additional Action (Provisions of FFA); Alternative A1: No Additional Action (Provisions of FFA); Alternative U1: No Additional Action (Provisions of FFA) for the Burial Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Does not achieve Human Health or Biota RAOs as untreated soils remain if controls are not implemented. Long-term reduction in toxicity of contaminants due to natural attenuation; no unacceptable short-term or cross media impacts.
2. Complies with ARARs	
a) Action-specific ARARs	a) Complies with action-specific ARARs as long-term monitoring and site reviews achieved.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Buried Trenches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA, but does not comply with Army regulations for agent or UXO.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. Chromium and lead above Human Health SEC and arsenic above Biota SEC remain in soils and may impact human health and biota; potential presence of agent/UXO remains.
b) Adequacy and reliability of controls	b) No controls implemented. Site reviews required.
c) Habitat impacts	c) Habitat quality not improved. Existing moderate-quality habitat not impacted by remedial alternative.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. No reduction in contaminant volume or mobility except by natural attenuation; 31,000 BCY of untreated soils remain; no reduction in hazards for agent or UXO presence.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) (See a.)
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. No workers involved.
b) Protection of community during remedial action	b) Protective of community. No fugitive dusts or vapor emissions.
c) Environmental impacts of remedial actions	c) No environmental impacts. Existing moderate-quality habitat not impacted by remedial alternative.
d) Time until RAOs are achieved	d) >30 years. Natural attenuation only process for contamination reduction; soils with potential agent and UXO remain on site.
6. Implementability	
a) Technical feasibility	a) Technically feasible. No implementation action required.
b) Administrative feasibility	b) Administratively feasible. No permitting required.
c) Availability of services and materials	c) Monitoring services readily available.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $0
c) Long-term	c) $900,000
d) Total	d) $900,000

Table 19.5-2 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the Burial Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils contained in on-post landfill, preventing human and biota exposure; no unacceptable short-term or cross-media impacts.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-11, A-16, and A-17)	a) Complies with action-specific ARARs including state regulations on landfill siting, design and operation achieved; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Burial Trenches Subgroup, incineration, and landfill not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) for agent and UXO.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 31,000 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Landfill cell monitoring required; no difficulties associated with landfill maintenance; high confidence in engineering controls of landfill.
c) Habitat impacts	c) Habitat quality improved at site. Revegetation of disturbed areas improves existing poor-quality habitat at site but eliminates habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through containment of 31,000 BCY in on-post landfill; soils with agent/UXO identified and treated.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, excavation, and transportation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to poor existing habitat.
d) Time until RAOs are achieved	d) 3 years. Excavation of 31,000 BCY feasible within 1 year after 2 years for construction of landfill and incinerator for agent.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably operated thereafter; landfill cells monitored; additional remedial actions require removal of landfill cover.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily implemented. Equipment, specialists, and materials (including clay) readily available for construction of landfill; landfills well demonstrated at full scale.

Table 19.5-2 Evaluation of Alternative 3: Landfill (On-Post Landfill); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the Burial Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) $1,600,000
b) Operating	b) $4,000,000
c) Long-term	c) $330,000
d) Total	d) $5,900,000

Table 19.5-3 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap); Alternative U2: Caps/Covers (Clay/Soil Cap) for the Burial Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through containment; contaminated soils above Human Health and Biota SEC covered by clay/soil cap, biota barrier, and vegetative layer, preventing exposure; no unacceptable short-term or cross-media impacts.
2. Complies with ARARs	
a) Action-specific ARARs (see Technology Description Document, Appendix A, Tables A-1 and A-5)	a) Complies with action-specific ARARs regarding construction of covers and monitoring of contained material; endangered species not impacted.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Burial Trenches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA but does not achieve Army regulations (AMC-R 385-131) regarding agent or UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Low residual risk. 31,000 BCY of untreated soils contained through installation of 43,000-SY clay/soil cap with biota barrier.
b) Adequacy and reliability of controls	b) Adequate controls. Long-term monitoring and site reviews required for untreated soils; erosion control and vegetative cover maintenance required; high confidence in engineering controls of clay/soil cap.
c) Habitat improved	c) Habitat quality improved. Revegetation of cap with native grasses improves habitat quality. Restrictions to burrowing animals help preserve integrity of cap and to prevent exposure.
4. Reduction in TMV through treatment	
a) Treatment process used and materials treated	a) No materials treated. Exposure pathways interrupted and mobility of contaminants reduced through installation of 43,000-SY clay/soil cap; soils with agent/UXO contained with clay/soil cap.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) Mobility reduction reversible if cap/cover degrades or leaks.
d) Type and quantity of treatment residuals	d) No treatment residuals associated with alternative.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance and installation.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impacts. Minimal impact to biota due to existing moderate-quality habitat.
d) Time until RAOs are achieved	d) 1 year. Installation of 43,000-SY clay/soil cap feasible within 1 year; natural attenuation of untreated soils ongoing.

Table 19.5-3 Evaluation of Alternative 6: Caps/Covers (Clay/Soil Cap); Alternative B5: Caps/Covers (Clay/Soil Cap); Alternative A2: Caps/Covers (Clay/Soil Cap); Alternative U2: Caps/Covers (Clay/Soil Cap) for the Burial Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative constructed within required time frame and reliably maintained thereafter; additional remedial actions easily undertaken for soils left in place, although cap adds to overall site volume.
b) Administrative feasibility	b) Administratively feasible. Achieves substantive requirements of cap/cover design and construction regulations.
c) Availability of services and materials	c) Readily implemented. Materials, specialists, and equipment and specialists readily available for cap/cover construction; clay/soil caps well demonstrated at full scale.
7. Present worth costs	
a) Capital	a) $0
b) Operating	b) $4,400,000
c) Long-term	c) $1,300,000
d) Total	d) $5,700,000

Table 19.5-4 Evaluation of Alternative 10: Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the Burial Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
1. Overall protection of human health and environment	Protective of human health and environment. Achieves RAOs through treatment/immobilization and containment; contaminated soils above Human Health SEC encapsulated, preventing exposure; soils above Biota SEC contained in on-post landfill, preventing exposure; no unacceptable short-term or cross-media impacts.
2. Complies with ARARs	
a) Action-specific ARARs(see Technology Description Document, Appendix A, Tables A-1, A-8, A-9, A-11, A-16, A-17, and A-18)	a) Complies with action-specific ARARs regarding monitoring of solidified material.
b) Location-specific ARARs (see Soils DSA, Volume II, Appendix A, Table A-2)	b) Complies with location-specific ARARs as Burial Trenches Subgroup not located in wetlands or 100-year floodplain.
c) Criteria, advisories, and guidances	c) Complies with provisions of FFA and Army regulations (AMC-R 385-131) regarding agent and UXO demilitarization.
3. Long-term effectiveness and permanence	
a) Magnitude of residual risks	a) Residual risk achieves PRGs at site. 31,000 BCY solidified and returned to site as backfill; 130 BCY of untreated soils contained in on-post landfill.
b) Adequacy and reliability of controls	b) Adequate controls. Monitoring of solidified soils required; high confidence in immobilization of contaminants.
c) Habitat improved	c) Habitat quality improved at site. Revegetation of disturbed areas moderate-quality habitat improves habitat at site but eliminates habitat at landfill.
4. Reduction in TMV	
a) Treatment process used and materials treated	a) Exposure pathways interrupted and mobility of contaminants reduced by solidification of 31,000 BCY and containment of 130 BCY in on-post landfill; soils with agent/UXO identified and treated.
b) Degree and quantity of TMV reduction	b) (See a.)
c) Irreversibility of TMV reduction	c) TMV reduction irreversible if integrity of solidified materials maintained; mobility reduction reversible if landfill fails.
d) Type and quantity of treatment residuals	d) 31,000 BCY of solidified soils backfilled and monitored.
5. Short-term effectiveness	
a) Protection of workers during remedial action	a) Protective of workers. Personnel protective equipment adequately protects workers during agent/UXO clearance, excavation, transportation, and treatment.
b) Protection of community during remedial action	b) Protective of community. Fugitive dust controlled by water spraying; vapor emissions not anticipated.
c) Environmental impacts of remedial actions	c) Minimal environmental impact. Minimal impact to biota due to existing moderate-quality habitat.
d) Time until RAOs are achieved	d) 5 years. Solidification of 31,000 BCY feasible within 3 years after construction of landfill and incinerator for agent treatment.
6. Implementability	
a) Technical feasibility	a) Technically feasible. Alternative implemented within required timeframe; solidified soils monitored to ensure integrity; landfill cells monitored.
b) Administrative feasibility	b) Administratively feasible. Achieve substantive requirements of treatment system and landfill siting, design, and operating regulations.
c) Availability of services and materials	c) Readily available. Equipment, specialists, and materials readily available for construction of landfill and solidification; solidification and landfills well demonstrated at full scale.

Table 19.5-4 Evaluation of Alternative 10: Direct Solidification/Stabilization (Cement-Based Solidification); Alternative B3: Landfill (On-Post Landfill); Alternative A4: Incineration/Pyrolysis (Rotary Kiln); Alternative U4a: Detonation (Off-Post Army Facility) for the Burial Trenches Subgroup

CRITERIA	ALTERNATIVE EVALUATION
7. Present worth costs	
a) Capital	a) \$1,200,000
b) Operating	b) \$8,500,000
c) Long-term	c) \$690,000
d) Total	d) \$10,000,000

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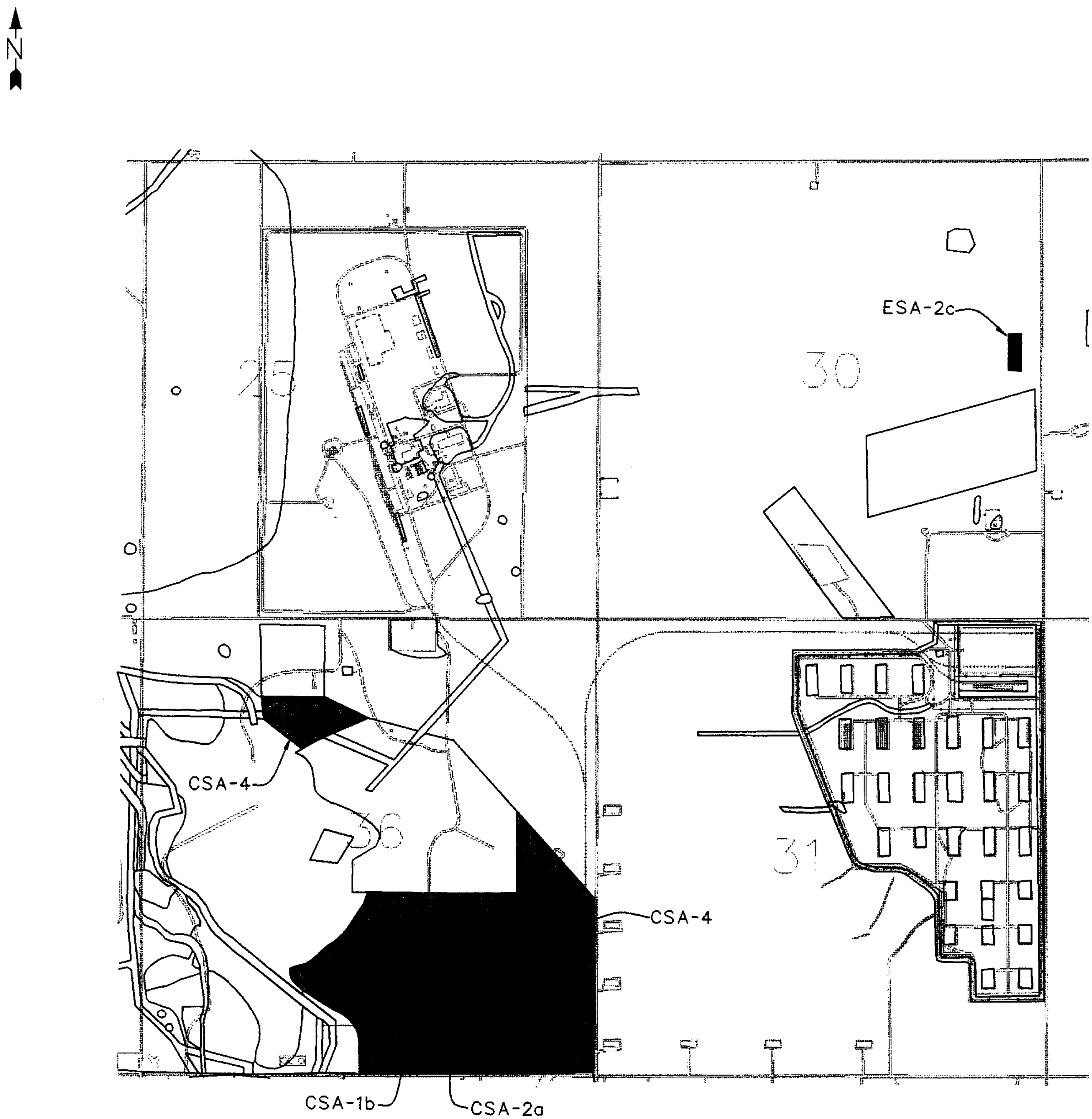
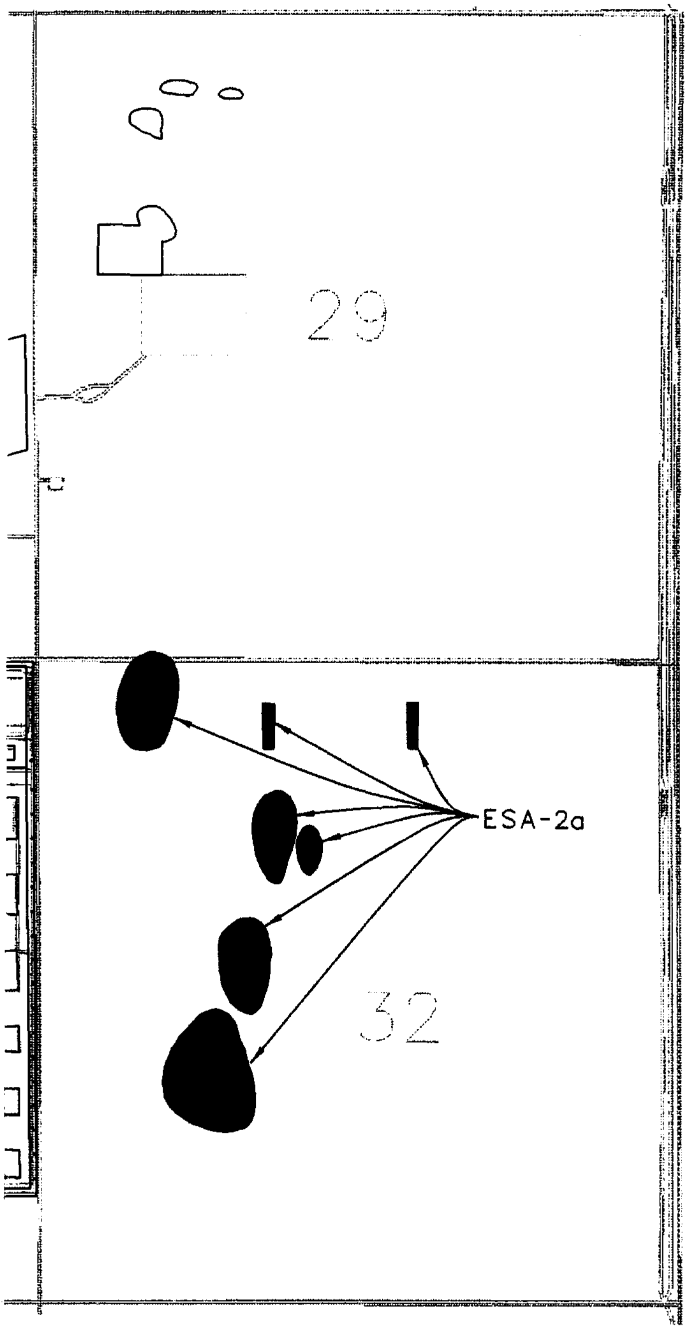
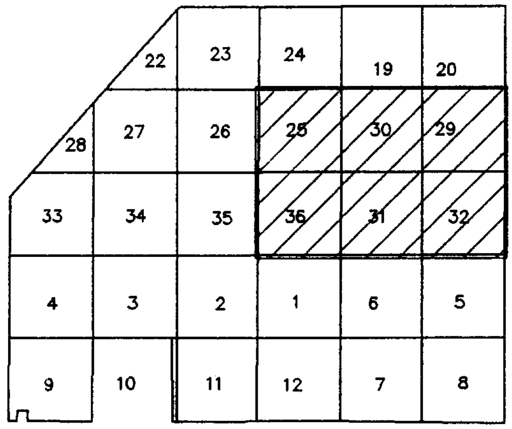




ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Burial Trenches Subgroup
SITES: ESA-2a, Section 32 Burn Pits
ESA-2c, Open Trenches

SECTION 36 Balance of Areas Subgroup
SITES: CSA-1b, Complex Disposal
Area South
CSA-2a, Munitions Testing Area
CSA-4, Balance of Areas Investigated

Shell Trenches Subgroup, Disposal
Trenches Medium Group

Site Boundary

Buildings and Roads

32 Section Number

750 0 750 1500 FEET

Prepared for:

U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 19.0-1

Site Locations
Undifferentiated Medium Group

Rocky Mountain Arsenal.
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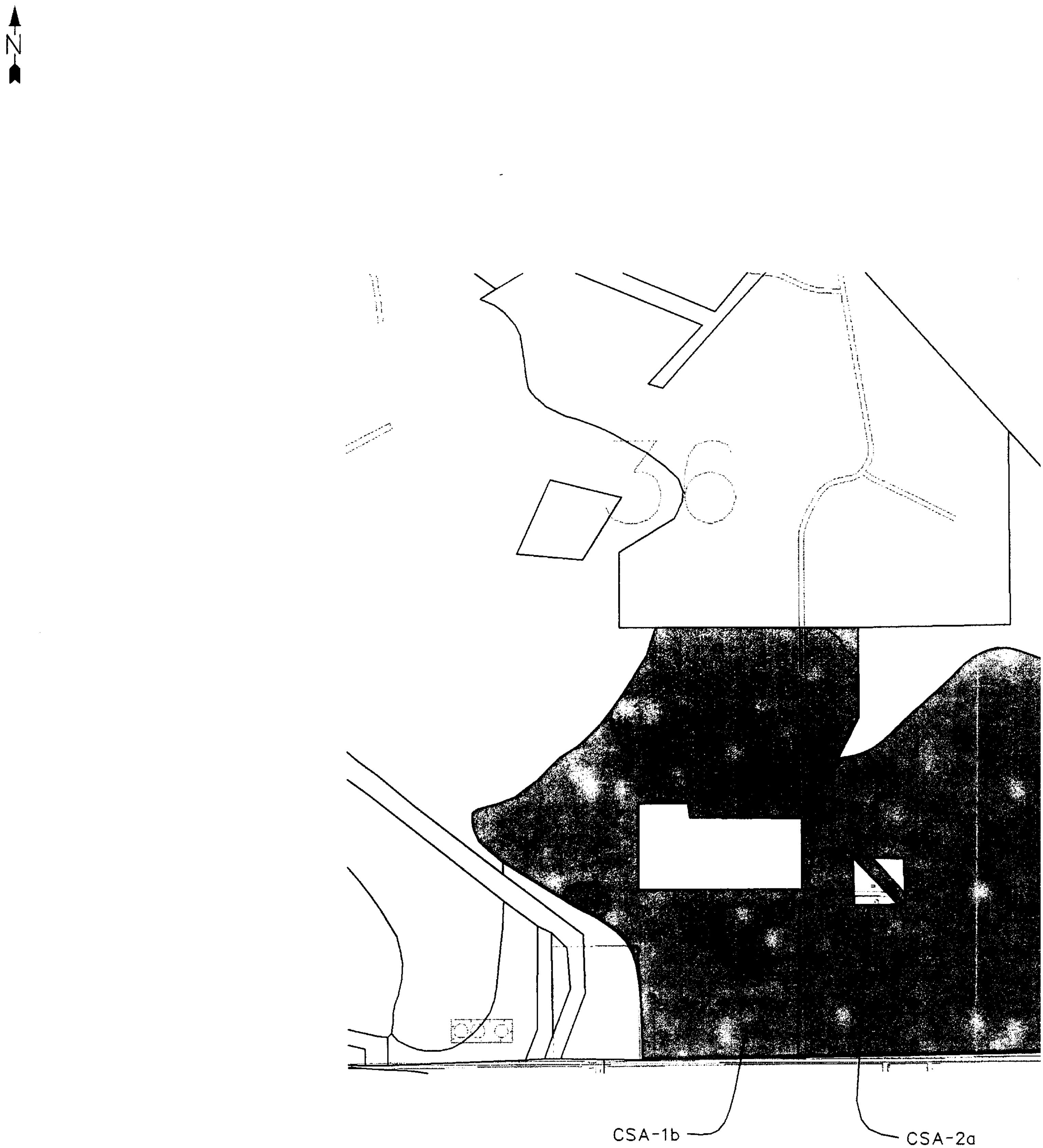
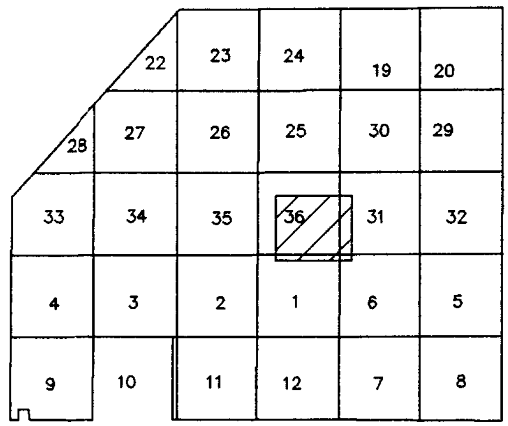
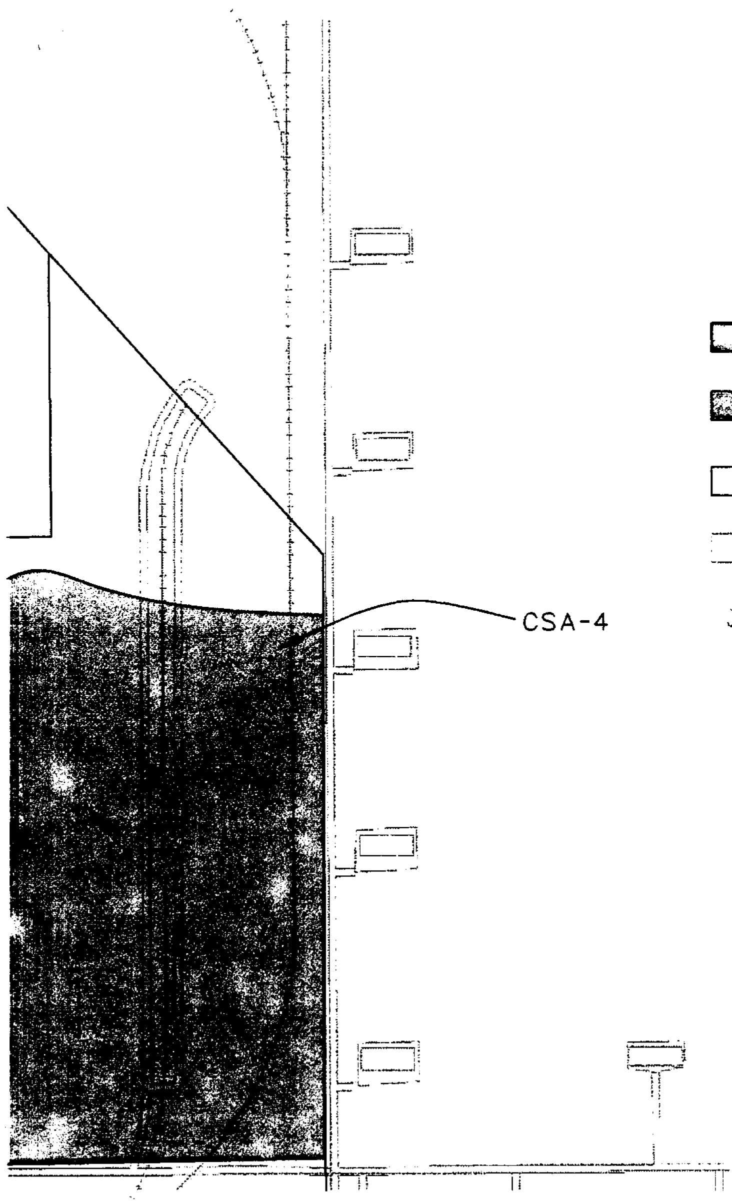


ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Biota Exceedance Area

Human Health Exceedance Area

Site Boundary

Buildings and Roads

32 Section Number

750 0 750 1500 FEET

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FIGURE 19.1-1

Exceedance Areas
Section 36 Balance of Areas
Subgroup

Rocky Mountain Arsenal.
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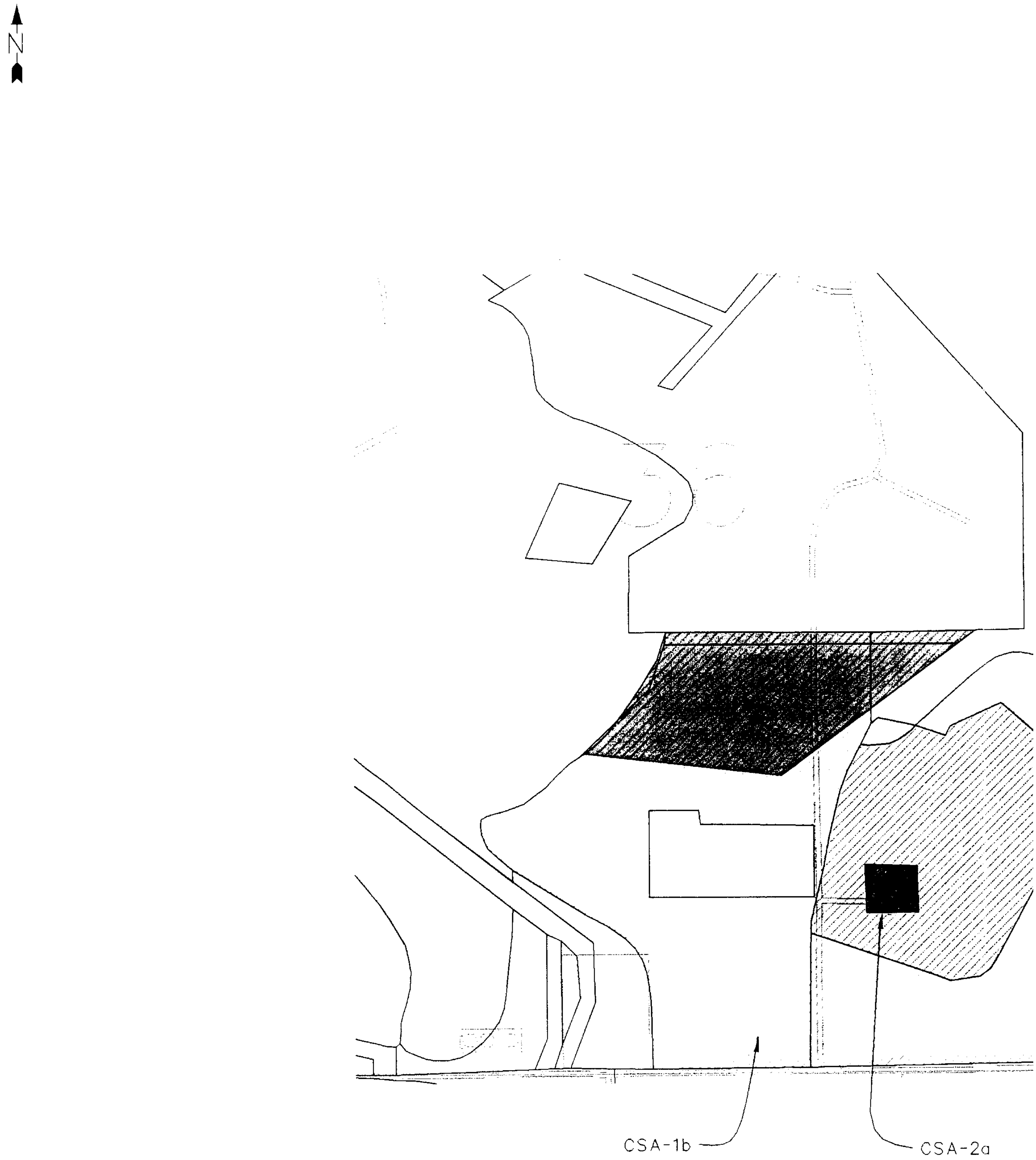

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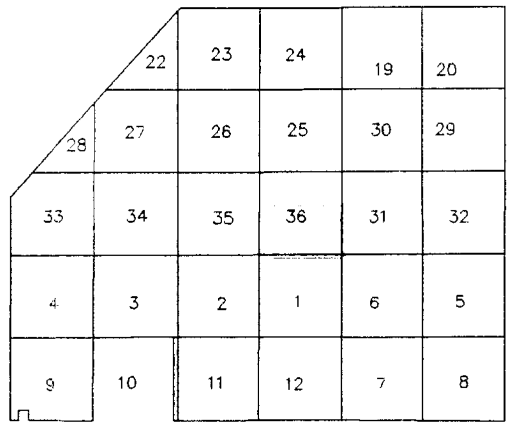
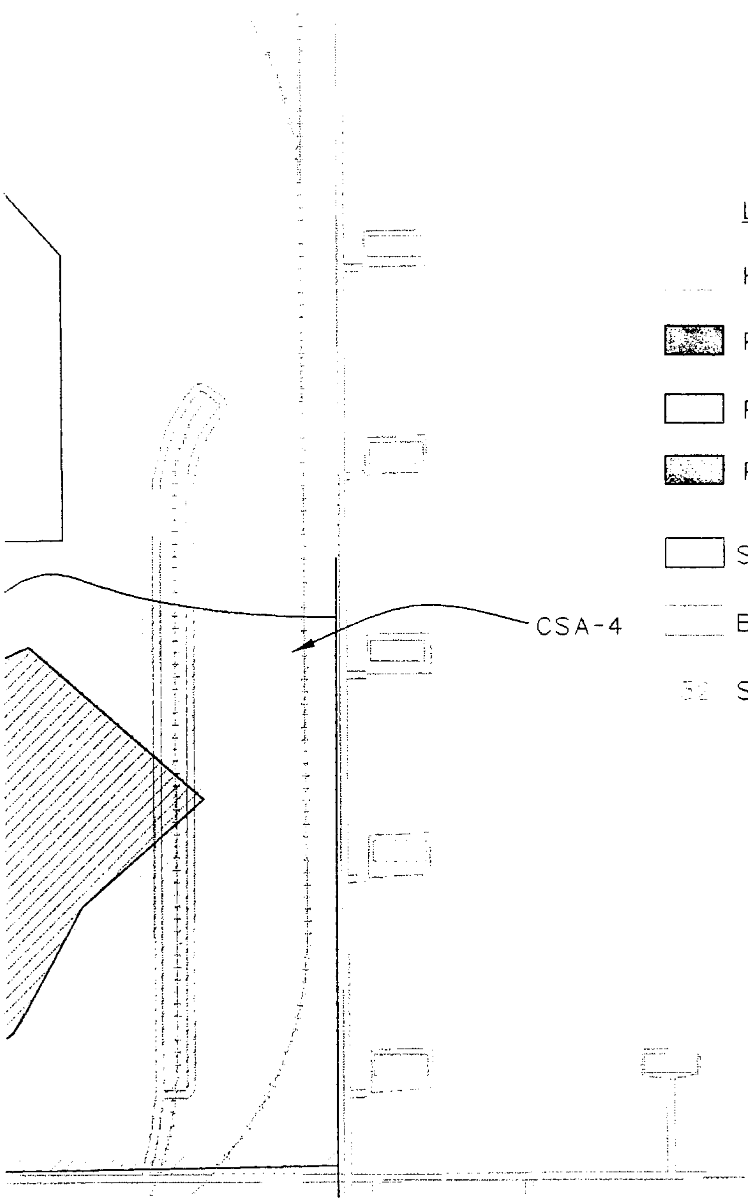
ROCKY MOUNTAIN ARSENAL
INDEX MAP





LEGEND

Human Health/Biota Exceedance Area

Potential Agent Presence Area

Potential UXO Presence Area

Potential Agent and UXO Presence Area

Site Boundary

Buildings and Roads

32 Section Number

750 0 750 1500 FEET

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U.S. Army Program Manager
for Rocky Mountain Arsenal

FIGURE 19.1-2

Potential Agent/UXO Areas
Section 36 Balance of Areas
Subgroup

Rocky Mountain Arsenal.
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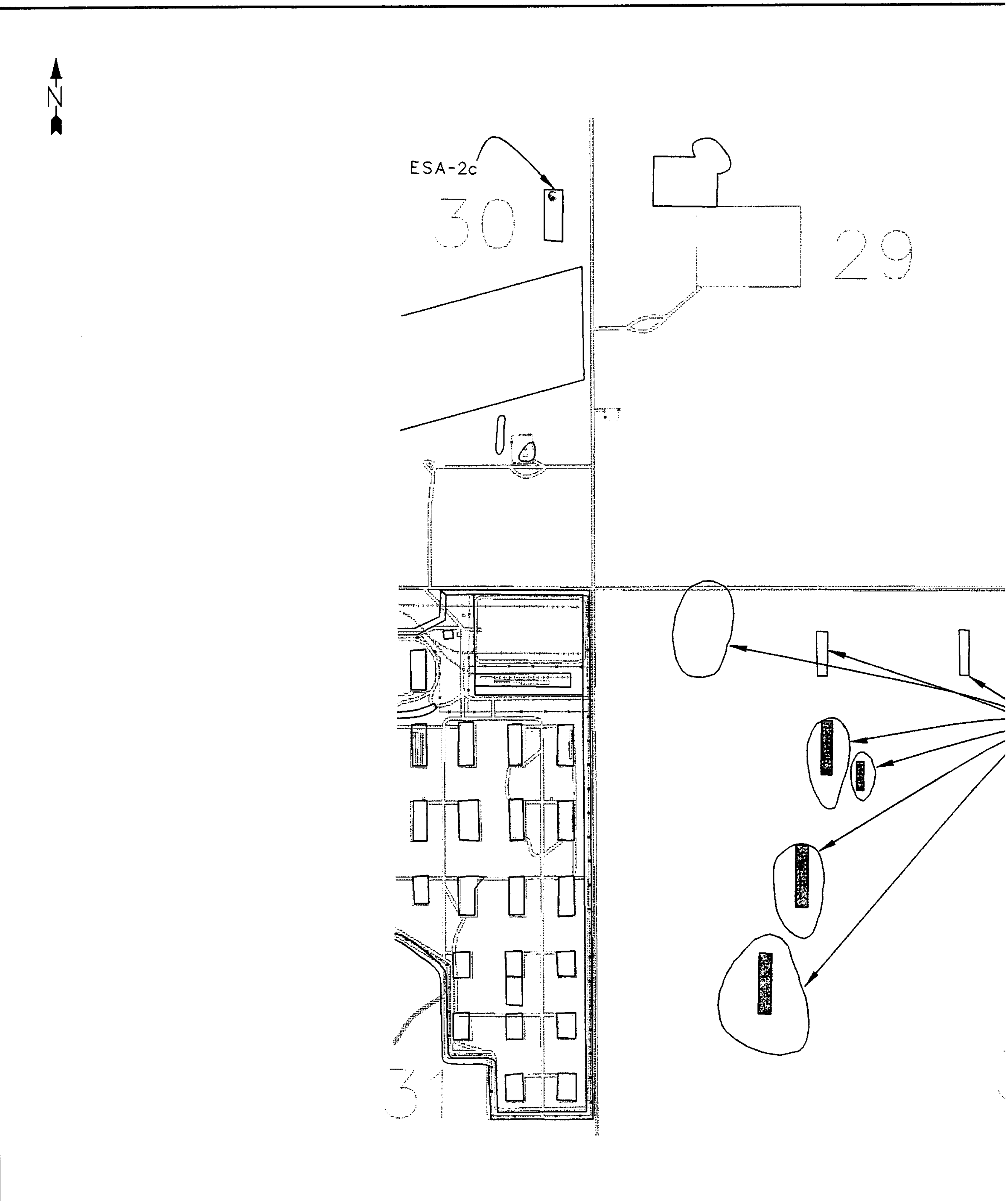
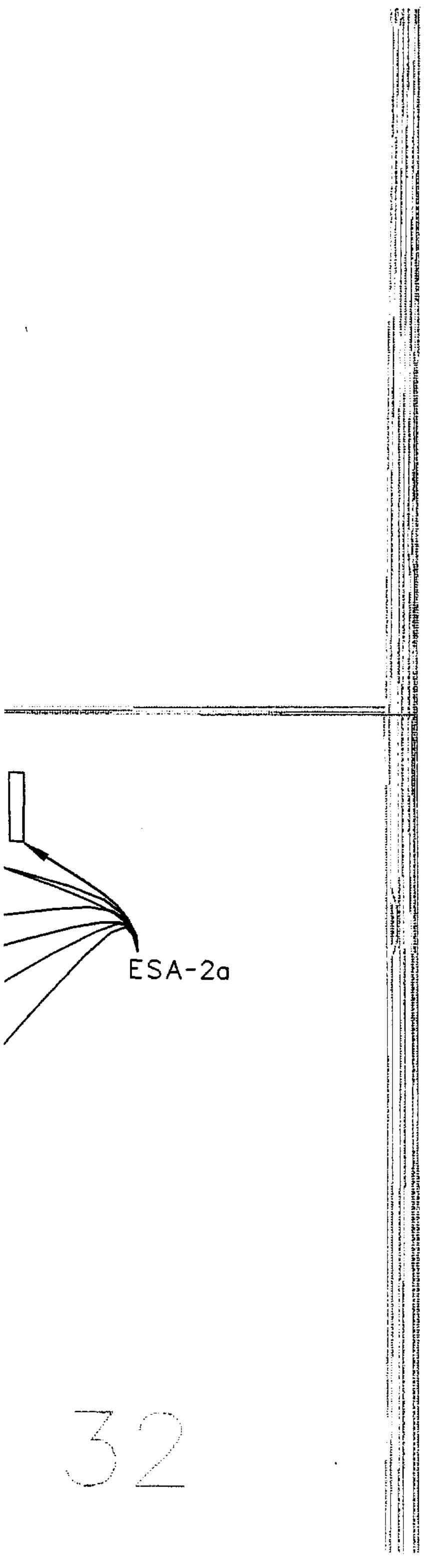
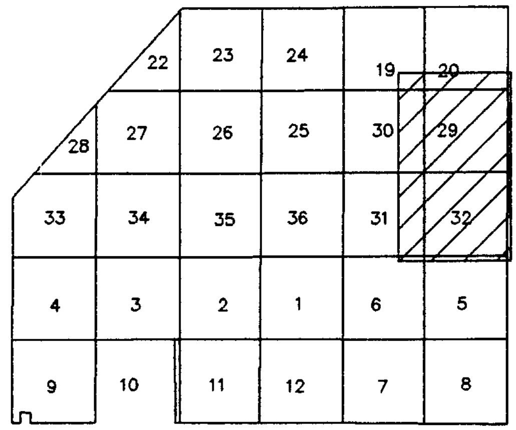




ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Human Health Exceedance Area

Site Boundary

Buildings and Roads

32 Section Nunber

500 0 500 1000 FEET

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FIGURE 19.4-1

Exceedance Area
Burial Trenches Subgroup

Rocky Mountain Arsenal.
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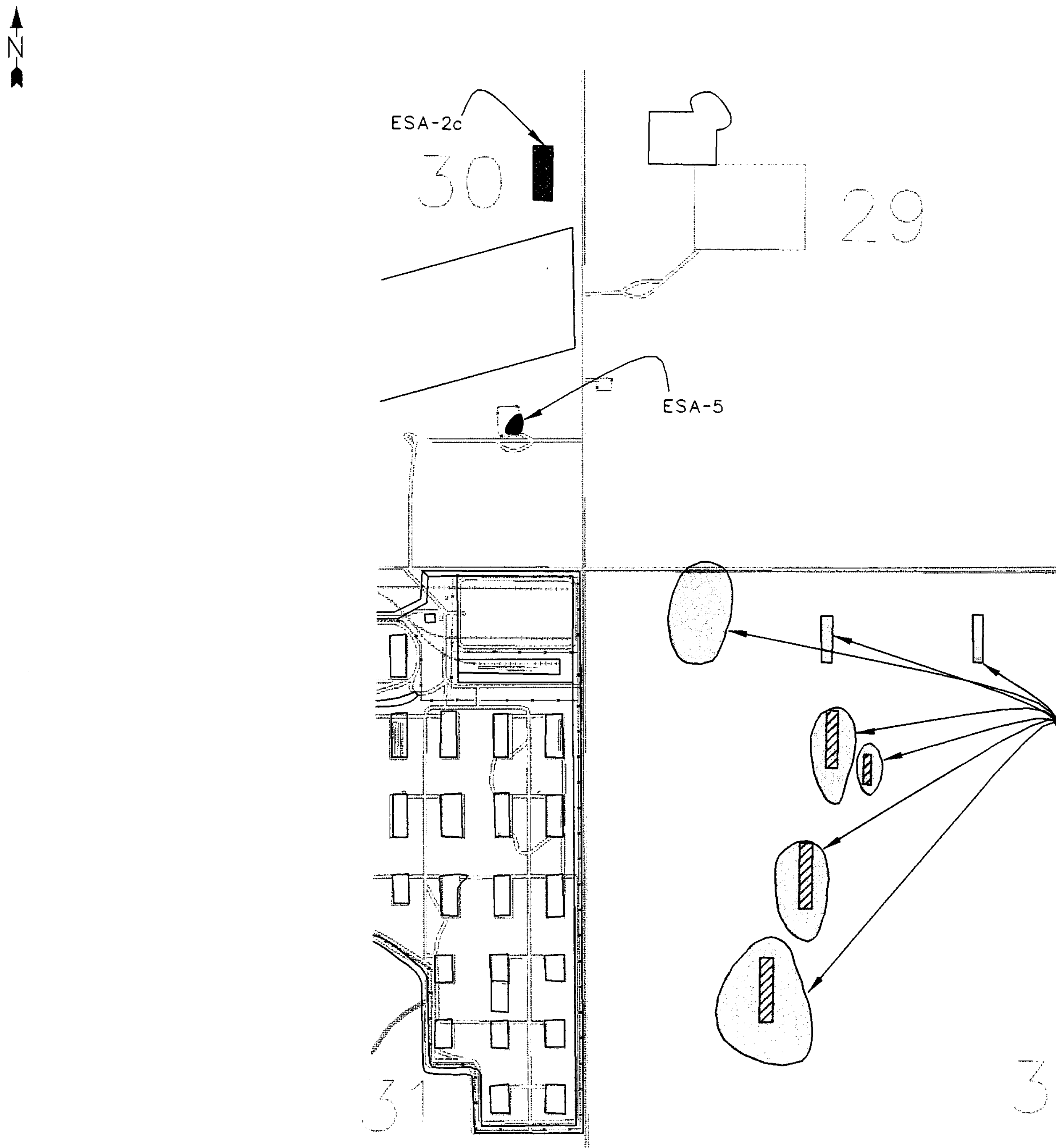

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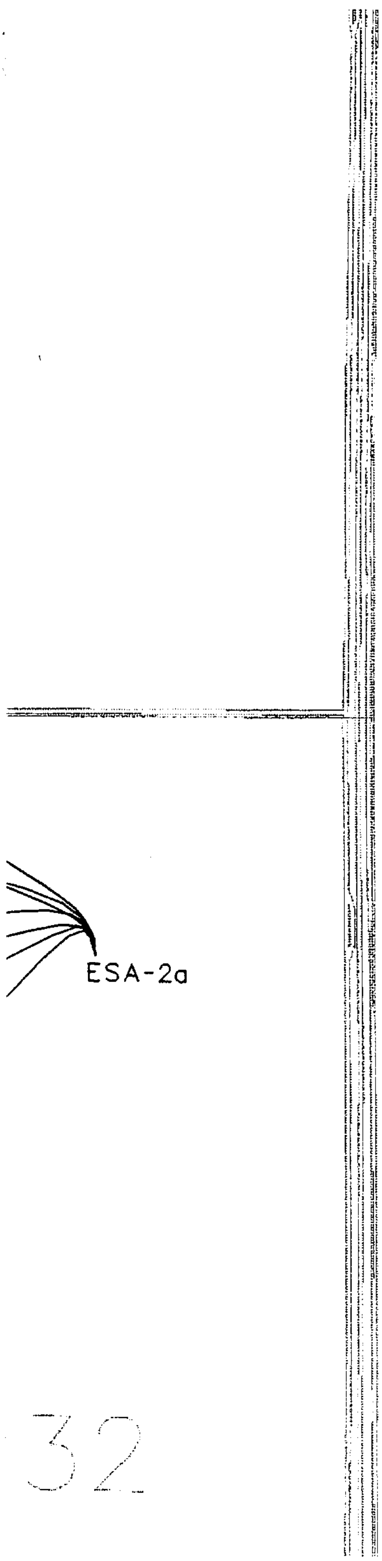
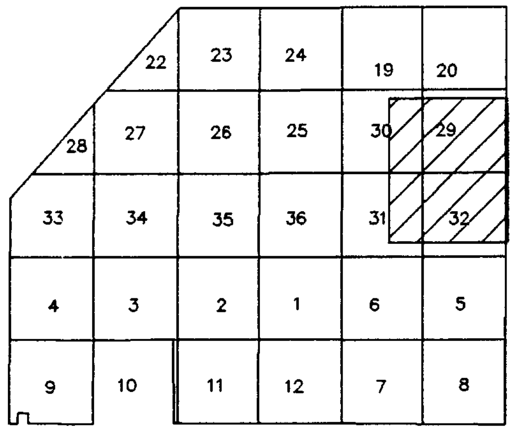


ROCKY MOUNTAIN ARSENAL
INDEX MAP



LEGEND

Human Health/Biota Exceedance Area

Potential Agent Presence Area

Potential UXO Presence Area

Potential Agent and UXO Presence Area

Site Boundary

Buildings and Roads

32 Section Number

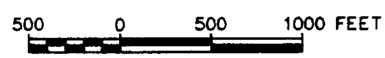


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FIGURE 19.4-2

Potential Agent/UXO Areas
Burial Trenches Subgroup

Rocky Mountain Arsenal.
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20.0 SUMMARY OF PREFERRED ALTERNATIVES

The following subsections summarize the preferred alternatives selected for each subgroup in the Potential Agent, Potential UXO, Biota and Human Health Exceedances Categories. Section 20.1 provides an overall analysis of alternatives developed for the soils medium, and subsequent sections (20.2 through 20.6) describe the selected alternative in more detail. Section 20.6 identifies the media interactions for preferred alternatives for soils, structures, and groundwater media. Section 20.7 addresses the adjustments required for several unit costs based on the volume of soils addressed at centralized treatment facilities for preferred alternatives, and Section 20.8 discusses several concepts relative to scheduling remedial actions at RMA for soils media. Refer to Sections 5 through 19 for the detailed evaluation of the alternatives developed for each medium group/subgroup.

20.1 SOILS PREFERRED ALTERNATIVES

Tables 20.1-1 through 20.1-15 summarize the selection of the preferred alternative for each of the soils medium groups/subgroups. Figure 20.1-1 presents an overview of the preferred alternatives for the 27 soils medium groups/subgroups, and Table 20.1-16 lists the total cost for each preferred alternative for each subgroup based on the adjusted unit costs (Section 20.7). The total present worth cost for the soils medium remedial alternatives at RMA is estimated to be approximately $530,000,000, based on the total cost of preferred alternatives utilizing the adjusted unit costs (Section 20.7).

The selection of the preferred alternatives for soils considers the statutory requirements of CERCLA and the expectations of the NCP (EPA 1990a) as identified below:

- Treatment of principal threats, wherever practicable
- Appropriate remedies will often combine treatment of higher-level contamination and containment of lower levels of contamination
- Containment will be considered for wastes that pose a relatively low long-term threat or where treatment is impracticable

- Institutional controls are most useful as a supplement to engineering controls for short- and long-term management
- Innovative technologies should be considered if they offer the potential for comparable or superior treatment performance, fewer or less adverse impacts, or lower costs for similar levels of performance than demonstrated technologies.

On an RMA-wide basis, the preferred alternatives for soils combine both treatment and containment. The preferred alternatives for soils comprise 11 basic types of remedial actions, ranging from access restrictions to incineration (Figure 20.1-1). These 11 overall remedial actions are as follows:

- Thermal desorption and direct solidification/stabilization, as needed, of principal threat volumes and containment of the remainder of the exceedance areas with a clay/soil cap.
- Thermal desorption of principal threat volumes and disposal of remaining exceedance areas in the on-post landfill.
- Thermal desorption of principal threat volumes and consolidation of remaining exceedance areas as grading fill in South Plants Central Processing Area for containment.
- Rotary kiln incineration of disposal trench materials from the Shell Trenches and Hex Pit Subgroups, off-post demilitarization of UXO through detonation/incineration, and rotary kiln incineration of agent-contaminated soils.
- Solidification/stabilization of exceedance areas that predominantly consist of inorganic contaminants.
- Installation of either a clay/soil cap or a composite cap to contain exceedance areas.
- Consolidation of exceedance areas to Basin A for containment as grading fill beneath a clay/soil cap.
- Disposal of exceedance areas in a centralized on-post landfill.
- Treatment of volatile organics by in situ vacuum extraction.
- Treatment of surficial soils by landfarm/agricultural practice.
- Initiation of access restrictions and plugging of sewer lines to interrupt exposure pathways.

In accordance with the NCP expectations, the preferred alternatives consist of treating the principal threats to the maximum extent practicable. Approximately 620,000 BCY of soils above the principal threat criteria are treated by thermal desorption, and 33,000 BCY of soils with inorganics above the principal threat criteria are solidified. The balance of the areas for the medium groups that contain principal threats have lower levels of contamination and are addressed through engineering controls, in accordance with the NCP guidelines outlined above. In addition, the preferred alternatives for soils include the treatment of 110,000 BCY of materials from the disposal trenches and soils with Army chemical agent by rotary kiln incineration. As a result, the 750,000 BCY of contaminated soils that exceed the principal threat criteria are treated as part of the soils preferred alternatives.

All of the soils identified as exceeding the principal threat criteria are treated, except for Basin F Wastepile and the disposal trenches, within the Complex Trenches Subgroup. EPA guidance on principal threat areas (EPA 1991b) indicates that situations exist where areas "identified as constituting a principal threat may be contained rather than treated due to difficulties in treating the waste." These situations occur when the extraordinary volume of materials or complexity of the site make implementation of treatment technologies impracticable, when implementation of a treatment-based remedy would result in greater overall risk to human health and the environment due to the risks posed to workers and the surrounding community during implementation, and when severe effects across environmental media would result from implementation of a treatment.

Although the Basin F Wastepile is considered a principal threat, the preferred alternative is installing a composite cap. The selection of this alternative is based on the consideration of the risks and potential impacts associated with excavation of the wastepile. As discussed in Section 11.3, the Basin F Wastepile is already contained with a liner and cover, which was installed as part of the Basin F IRA. The installation of a composite cap over the existing cover and associated modification to the sump in Cell 2 further ensures that exposure pathways are interrupted and the potential for migration of contaminants to groundwater is minimized. In

addition, the leachate generated is greatly reduced and is collected and treated. If the Basin F Wastepile were excavated for treatment, extensive and unproven engineering controls would be required including a vapor enclosure over the entire exceedance area to control emissions. Since the wastepile is effectively contained by installing a composite cap, treatment of wastepile material entails a greater overall risk and has the potential to severely impact air quality. As such, the selection of the capping alternative for the Basin F Wastepile is consistent with the NCP guidelines regarding principal threats.

The Complex Trenches Subgroup includes principal threat volumes within the disposal trenches that consist of a complex mixture of debris, UXO, agent-contaminated materials, and containerized waste. As discussed in Section 14.3, the excavation of these trenches presents a significant risk to site workers due to the physical and acute chemical hazards present in the trenches; therefore, the selection of the containment alternative is consistent with the NCP. Even though emissions from excavation are controlled with a vapor enclosure, the materials present within the trenches represent a potential risk to the surrounding community during excavation since the vapor enclosure may not be adequate to control acute chemical hazards or detonation. Furthermore, the treatment of the disposal trench materials requires the separation of oversize debris prior to rotary kiln incineration, which results in a portion of the debris being landfilled without treatment due to the size of the debris. Due to the nature of the debris and the physical hazards present, excavation of the trenches and separation of the debris is impracticable. As such, the selection of the containment alternative for the Complex Trenches Subgroup is consistent with NCP guidelines regarding principal threats.

The NCP indicates that institutional controls generally should not be substituted for treatment or engineering controls; however, the institutional controls alternative is selected for the Sanitary/Process Water Sewers Subgroup. Soils in this subgroup do not show near-surface contamination and only sporadically show detections at depths of more than 6 ft. Furthermore, the contamination levels along the sewers are low (less than one order of magnitude above the SEC), and the Sanitary Sewers IRA (which involves pipe plugging) has reduced the migration

of groundwater. As such, the selection of institutional controls for this subgroup is protective of human health and the environment.

The remaining preferred alternatives for the soils medium consist primarily of containment since the soils contain low levels of contamination and pose a relatively low long-term threat. Approximately 810,000 BCY of contaminated soils and debris are excavated and placed in the on-post landfill and 1,500,000 SY of contaminated soils and debris are capped. Approximately 2,000,000 BCY of soils are consolidated as grading fill prior to containment. The capping of Basin A requires between 1,200,000 and 1,800,000 BCY of fill to achieve the design grades for capping. Based on the preferred soils alternatives, 1,100,000 BCY of contaminated soils are consolidated in Basin A from various portions of RMA as grading fill. The South Plants Central Processing Area Subgroup requires between 500,000 and 1,000,000 BCY of fill to achieve the design grades for capping, and 890,000 BCY of contaminated soils are consolidated as grading fill from the remainder of South Plants. Another 70,000 BCY of soils from the exterior of the trench areas are consolidated within the Complex Trenches Subgroup.

The NCP also indicates a preference for the selection of innovative technologies. Thermal desorption is the major treatment technology selected as part of the preferred alternatives, and is considered an emerging technology compared to rotary kiln incineration. As discussed in the Soils DSA (Volume I), thermal desorption offers the potential for comparable treatment levels and results in superior levels of performance with fewer impacts for soils with inorganics since fewer inorganics are volatilized. Furthermore, thermal desorption has a lower cost compared to rotary kiln incineration. As such, the thermal desorption of 620,000 BCY of principal threat soils is in accordance with the expectations of the NCP.

Figure 20.1-12 shows the reference areas for the caps and landfills that require long-term management. As discussed in Section 3.1, the evaluation of alternatives considers how to minimize long-term management areas and maximize areas without wildlife restrictions. Leachate from the Basin F Wastepile and the centralized landfill are collected and treated as part

of long-term maintenance. The long-term management consists of annual groundwater monitoring for the wastepile and the landfill as well as the capped areas. The caps, landfill, and wastepile also need to be maintained to provide adequate ground cover, and a site review is conducted every 5 years. Long-term management will be necessary following closure.

20.2 HUMAN HEALTH EXCEEDANCE CATEGORY

Figure 20.2-1 summarizes the preferred alternatives for the human health exceedance areas, and this subsection describes these preferred alternatives. As discussed above, 750,000 BCY of contaminated soils classified as principal threats are treated. The selection of capping alternatives for the Basin F Wastepile Medium Group and the Complex Trenches Subgroup is discussed in Section 20.1 and in Tables 20.1-7 and 20.1-10, respectively. The following sections provide a brief description of the preferred alternatives for the medium groups and subgroups within the Human Health Exceedance Category based on the 11 overall remedial actions.

20.2.1 Access Restrictions and Sewer Plugging

The preferred alternative for the Sanitary/Process Water Sewers Subgroup is Alternative 2: Access Restrictions (Modifications to FFA, closure), which applies to the estimated 170,000 BCY of human health and biota exceedance volume that remains in place. The access restrictions and the depth of contaminated soils (6 to 10 ft below ground surface) limit potential exposure to the contaminated soils at the site. The estimated 7,000 CY of void space inside sanitary sewer lines and manholes is plugged with a concrete mixture. Manhole excavations are placed 100 ft apart for sewers with inadequate access. Pipe plugging reduces access to these lines and eliminates them as a potential migration pathway for contaminated groundwater. Aboveground warning signs are posted every 1,000 ft along sewer lines to indicate their location underground. Information on the sanitary sewer lines is included as part of the ongoing program to educate the public about areas where contaminants are left in place as discussed in Section 3.1 of the Technology Description Volume.

20.2.2 On-Post Centralized Landfill

For the Burial Trenches Subgroup and the Sanitary Landfills Medium Group the preferred alternative is Alternative 3: Landfill (On-Post Landfill) (Tables 20.1-15 and 20.1-11, respectively). The contaminated 500,000 BCY of soil and debris for these two groups is excavated and placed in the centralized on-post landfill. Section 6.5 of the Technology Description Volume presents a detailed discussion of the operation and construction of a centralized landfill. The liner and cover of each individual cell within the landfill consists of composite low-permeability layers, which are comprised of a geomembrane overlying a compacted low-permeability soil layer 2- to 3-ft thick. Daily soil covers are installed during operation of the landfill, and long-term post-closure monitoring and maintenance activities are conducted. The sizing and placement of the on-post landfill is based on the volumes to be landfilled for preferred alternatives as discussed in Section 20.7. Conventional excavation of contaminated soils and the choice of specific excavation equipment is primarily based upon site-specific needs. During excavation, dust suppression measures are implemented. Following excavation, the disturbed areas are backfilled with borrow material obtained on post and compacted to prevent future subsidence. Topsoil obtained from off post is placed over the backfilled area, and the area is then regraded and revegetated with native grasses to improve habitat.

Prior to excavating the soils from the Burial Trenches Subgroup for landfilling, an isolated area of 7,100 SY will be screened for agent using real time field analytical equipment. Soils identified as containing agent will be treated by incineration. The remaining portions of this subgroup will be cleared for UXO using geophysical technologies. Any identified UXO are anticipated to be HE-filled and will be excavated, packaged, and transported off post for detonation at an existing Army Facility.

20.2.3 Thermal Desorption/Centralized Landfill

On-post landfilling is also the preferred alternative for the contaminated soils that do not exceed the principal threat criteria in the Chemical Sewers Subgroup. Soils above principal threat criteria,

47,000 BCY, are excavated using backhoes instead of conventional earth-moving equipment, and treated by thermal desorption, which is discussed in Section 7.1 of the Technology Description Volume. During excavation operations, dust is suppressed and emissions of volatiles and odors are controlled. The excavation of the sewers entails the removal of 340,000 BCY of overburden soils. The remaining 31,000 BCY of contaminated soil and sewer debris, which exceeds the Human Health SEC, are placed in the on-post landfill. During the excavation of contaminated soils and sewer debris, agent screening is conducted to identify those soils and debris that are contaminated with agent. Soils contaminated with agent are excavated and transported to the rotary kiln incinerator to be incinerated in accordance with Alternative A4 as discussed under North Plants Subgroup (Section 20.4).

Due to the potential for odor problems, the excavation of overburden and exceedance soils is conducted so that minimal area is uncovered and exposed at any one time, and daily soil covers or plastic sheeting are placed over the excavated areas. Prior to excavation of the sewer lines in South Plants, the structures along and above the sewer line are demolished and removed to allow access to the sewers. While removing the chemical sewer system, abandoned utilities are removed and the debris consolidated with the structural debris. Cast iron and steel sewer pipe are sized, crushed, and screened prior to entering the thermal desorber for treatment. Sewer pipe excavated from the remaining human health areas are sized and transported to the hazardous waste landfill for disposal. 31,000 BCY of backfill material from an on-post borrow area is required to replace the contaminated soil that is contained in the landfill.

20.2.4 Clay/Soil Cap and Composite Cap

The preferred alternative for the Complex Trenches Subgroup is Alternative 5b: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Consolidation. A soil/bentonite slurry wall, as described in Section 4.5.8 of the Technology Description Volume, is installed into competent bedrock (up to 28 feet below grade) around the perimeter of the disposal trench area (8,700 ft total) to create an isolation cell. A total of four separate clay/soil caps will be installed and encompassed by slurry walls. The 70,000 BCY of human health and biota exceedance soils from

the perimeter of the trench areas are excavated and consolidated within the isolation cell for containment. Prior to excavation, the soil to be consolidated is cleared by geophysics to locate UXO. Identified UXO is excavated, packaged, and transported off post for demilitarization at existing Army facilities. The 18,000 BCY of metallic debris mixed with surfical soils from cleared UXO areas are placed into the on-post hazardous waste landfill. UXO containing agent that are rendered safe for transportation are shipped to an Army facility designed specifically for agent-filled UXO demilitarization.

Prior to excavation of soils for consolidation, agent screening is conducted using real-time field analytical equipment. Soils with positive screens are stockpiled and covered. If agent presence is confirmed by analysis from the RMA laboratory, the contaminated soil is incinerated. The consolidation of 70,000 BCY of contaminated soils from outside the trench areas reduces the area that must be monitored in the long term. The excavation of soils in the vicinity of the trenches requires odor control measures to minimize any volatilization, but the consolidation of soils presents a much lower short-term risk than the excavation of the trenches themselves.

As part of the containment of the Complex Trenches subgroup, long-term dewatering is required to ensure the inward migration of groundwater. The dewatering system creates an inward gradient within the cell, minimizing the potential for further groundwater contamination. Groundwater removed from the cell is pumped to the CERCLA Wastewater Treatment Plant. Following the slurry wall installation, agent screening, and UXO clearance, the consolidated soils and the disposal trench areas are contained with a 130,000 SY clay/soil cap. Long-term maintenance activities ensure the continued integrity of the soil cover and operation of the dewatering system. Five-year site reviews are conducted to assess potential migration of contaminants and the integrity of the containment system.

The preferred alternative for the Section 36 Lime Basins Subgroup is augmenting the existing soil cover to form a clay/soil cap. The uppermost 2 ft of the soil cover are removed and stockpiled. The 2-ft low-permeability soil and 1-ft biota barrier layers of the clay/soil cap are

installed over the remaining soil cover. The stockpiled soils and 2 ft of borrow materials are utilized to form the soil/vegetation layer of the clay/soil cap. The clay/soil cap is then revegetated with native grasses, and long-term maintenance activities are initiated.

The containment of the Basin F Wastepile is augmented through the installation of a composite cap. The uppermost 2 ft of the existing soil cover are removed, stockpiled, and incorporated into the soil/vegetation layer of the composite cap. The installation of the composite cap and associated modifications to the sump in Cell 2 further interrupts exposure pathways and minimizes infiltration and leachate generation. The leachate removal systems will continue to remove any leachate generated, and the leachate will be drummed and treated off post at a commercial facility.

20.2.5 Consolidation as Grading Fill

The preferred alternative for the Secondary Basins, Basin F Exterior, Buried Sediments, Sand Creek Lateral, and Section 36 Balance of Areas Subgroups consists of consolidating exceedance soils in Basin A as grading fill prior to installing a clay/soil cap over Basin A. The exceedance souls from these areas are excavated with conventional earth-moving equipment and transported to Basin A. The soils are placed, graded and compacted as a subgrade for the containment of Basin A. As discussed in Section 20.1, approximately 1,100,000 BCY of consolidated soils will be placed in Basin A, which will achieve the design grades for installing a clay/soil cap. During excavation, dust is suppressed, and emissions of volatiles and odors are controlled. The excavations are backfilled with borrow soils, covered with 6 inches of topsoil and revegetated.

Prior to consolidating the soils from the Section 36 Balance of Areas Subgroup into Basin A, construction dewatering operations will be required to allow safe excavation of soils at the water table. The dewatering system will be installed 2 years prior to excavation activities and will be operated until excavation activities are complete. The water removed during dewatering will be treated at the CERCLA Wastewater Treatment Facility. Prior to excavation, the area will be cleared using geophysical technologies to locate UXO. Identified UXO will be excavated,

packaged and transported off post for demilitarization at existing Army facilities. Approximately 70,000 BCY of metallic debris mixed with soil will be excavated and transported to the on-post hazardous waste landfill. Prior to excavation of soils for consolidation, agent screening is conducted using real-time field analytical equipment. Soils with identified agent will be treated by rotary kiln incineration.

20.2.6 Thermal Desorption/Consolidation

The preferred alternative for the South Plants Ditches and South Plants Balance of Areas Subgroups consists of treating the soils exceeding the principal threat criteria by thermal desorption and consolidating the remaining soils within the South Plants Central Processing Area for containment. During excavation operations, dust is suppressed and emissions of volatiles and odors are controlled. The excavation of the exceedance soils for these subgroups entails the demolition and removal of a number of structures within South Plants. The 25,000 BCY of soils exceeding the principal threat criteria are excavated and treated by thermal desorption, which is discussed in Section 7.1 of the Technology Description Volume. A total of 89,000 BCY of contaminated soils are consolidated within the Central Processing Area for containment. The placement of these soils as grading fill achieves the design grades for a clay/soil cap.

Prior to treating and consolidating soils from the South Plants Balance of Areas Subgroup, an isolated portion of the subgroup (15,000 SY) will be cleared for UXO using geophysical technologies. Any identified UXO will be excavated, packaged, and transported off post for detonation at an existing Army facility, since only HE-filled UXO are anticipated, metallic debris mixed with soil will be excavated from this area and transported to the on-post hazardous waste landfill. Approximately 43,000 SY of this subgroup will be screened for agent prior to excavation using real-time field analytical equipment. Soils identified as containing agent will be treated by rotary kiln incineration.

20.2.7 Thermal Desorption/Clay/Soil Cap

The preferred alternative for the Basin A, Former Basin F and South Plants Central Processing

Area Medium Groups/Subgroups consist of treating the soils exceeding the principal threats criteria by thermal desorption and containing the balance of the exceedance area with a clay/soil cap. During excavation operations, dust will be suppressed, and vapor emissions and odors will be controlled. The operation of a thermal desorption unit, including materials handling and off-gas treatment, are discussed in Section 7.1 of the Technology Description Volume.

For the Former Basin F Subgroup, the existing soil cover is removed as overburden prior to excavating the principal threats areas for thermal desorption. The uppermost 2 ft of the existing soil cover are removed over the total 420,000-SY exceedance area, stockpiled, and incorporated into the soil/vegetation layer of the clay/soil cap.

Approximately 1,100,000 BCY of contaminated soils are consolidated into Basin A prior to capping from nearby sites. Similarly, 890,000 BCY of contaminated soils are consolidated within the Central Processing Area from other portions of South Plants. The consolidation of these soils in Basin A and South Plants Central Processing Area form the subgrade for installing a clay/soil cap.

20.2.8 Solidification/Stabilization

The preferred alternative for Buried M-1 Pits is Alternative 10: Direct Solidification/Stabilization (Cement-Based Solidification) which includes the excavation of soils exceeding the Human Health SEC by conventional earth-moving equipment. Prior to excavation, the soils are screened for agent and any soils identified as containing agent are treated by rotary kiln incineration. The contaminated soils are solidified by adding cement as a binder at a 20-percent ratio to immobilize arsenic, mercury, and ICP metals in the soils. The solidified soils are placed in the site excavations and covered with 4 ft of on-post borrow soil and a topsoil obtained from off post. The soil cover ensures the integrity of the solidified materials and prevents freeze/thaw degradation of the materials. The soils may be capped as part of the remediation of the South Plants Central Processing Area instead of with a 4-ft soil cover. The cover is revegetated to improve habitat quality at the site.

20.2.9 Rotary Kiln Incineration

The preferred alternative for the Shell Trenches and Hex Pit Subgroups is Alternative 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill). The 100,000 BCY of principal threat volumes for these subgroups are excavated and treated by rotary kiln incineration, which is described in Section 7.2 of the Technology Description Volume. Dewatering is required for the Shell Trenches to allow the excavation of soils and debris from near the water table. This dewatering system will be installed 2 years prior to excavation and will remain operational until excavation operations are complete. The groundwater removed from this system will be treated at the CERCLA Wastewater Treatment Facility. The disposal trenches are excavated inside a vapor enclosure to control vapors as described in detail in Section 14 for both subgroups. The vapor enclosure includes emissions controls equipment to prevent the buildup of toxic gases inside the enclosure.

Excavated soils from the subgroups in this medium group that contain inorganic exceedances are not treated by direct solidification/stabilization following rotary kiln incineration. The large amounts of debris present in these soils would necessitate intensive pretreatment and materials separation prior to solidification stabilization. Therefore, these materials are placed directly into an on-post landfill following thermal treatment.

20.2.10 Soil Vapor Extraction

As discussed in Table 20.1-13, the preferred alternative for the South Plants Tank Farm Subgroup is Alternative 16a: In Situ Physical/Chemical Treatment (Vacuum Extraction). The technology is the most cost effective in removing VOCs and it is consistent with NCP guidance on treatment of more mobile contaminants. Alternative 16a is also cost effective in remediating OCPs in surficial soils using landfarm/agricultural practices. In addition, Alternative 16a easily complements an in situ treatment alternative for groundwater or a groundwater pump-and-treat system for the South Tank Farm Plume.

20.3 BIOTA EXCEEDANCE CATEGORY

This subsection describes the preferred alternative for the three medium groups within the Biota Exceedance Category and for the biota exceedances within the human health medium groups (Figure 20.3-1). Since the biota exceedances consist of low levels of OCPs, arsenic, and mercury that are considered to exhibit low long-term threats, the preferred alternatives for the biota exceedance areas consist of containment technologies or in situ surface treatments in accordance with the expectations of the NCP. The preferred alternatives are discussed based on the overall remedial actions for the soils media.

20.3.1 Landfarm/Agricultural Practices

Alternative B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) is the preferred alternative for the majority of the biota exceedances and applies to 7,500,000 SY of the Basin F Exterior, Surficial Soils, and South Plants Tank Farm Medium Groups/Subgroups. This alternative reduces the mobility and the exposure pathways for contaminants in surface soils with a lower habitat impact than other alternatives (Table 20.1-4.) Farm machinery is used to till and seed the soil with native grass. Initially, the soil hard pan is ripped where the ground is initially too hard for a plow to penetrate. A plow with 6- to 8-inch bottoms is used to cover the upper 2 inches of contaminated soil with uncontaminated soil from below the 0- to 2-inch depth internal. With the contaminated soil covered, dust dispersion and exposure of surface receptors is minimized. The final step uses a disk to break up soil chunks and uniformly mix the soil. Fertilizer and mulch are applied, and a mixture of native grasses is seeded to facilitate development of a stable final grass stand (in accordance with a refuge management plan), aid soil conservation, and prevent dust dispersion.

20.3.2 Consolidation as Grading Fill

The preferred alternative for most of the biota exceedance soils in South Plants and several of the ditches is Alternative B5a: Caps/Covers (Clay/Soil Cap) with Consolidation. The contaminated soils in the sites located in South Plants are excavated and placed in the South Plants Central Processing Area which is then capped with a clay/soil cap. The remaining biota

exceedance volumes for consolidation are excavated and placed in Basin A, which is also capped. The consolidation of human health exceedances into Basin A and the South Plants Central Processing Area are discussed in Sections 20.2.5 and 20.2.6, respectively. A total of 1,100,000 BCY of contaminated soils are consolidated into Basin A, and 890,000 BCY are consolidated into the South Plants Central Processing Area. The excavated sites are backfilled and revegetated.

20.3.3 On-Post Centralized Landfill

130 BCY of contaminated soils from the Burial Trenches Subgroup and 3,200 BCY of contaminated soils from the Sanitary Landfills Subgroup are excavated and placed in the on-post landfill in conjunction with the landfilling of the human health exceedance areas for these two subgroups. The excavated sites are backfilled and revegetated to restore the habitat at the site.

20.3.4 Clay/Soil Cap

Alternative B5: Caps/Covers (Clay/Soil Cap) is the preferred alternative for the biota exceedances in the South Plants Central Processing Area, Basin A, Section 36 Lime Basins, and Former Basin F Medium Groups/Subgroups. A clay/soil cap is placed in the South Plants Central Processing Area Subgroup and the Basin A Medium Group following treatment of principal threat areas and consolidation as discussed in Section 20.2.7. For biota exceedances within the Section 36 Lime Basins and the Former Basin F Subgroups, the soil cover is augmented to form a clay/soil cap as discussed in Section 20.2.4.

20.3.5 No Additional Action

The preferred alternative for the biota exceedance area Sanitary/Process Water Sewers is B1: No Additional Action (Provisions of FFA) (Table 20.1-9). The 19,000 SY of contaminated soil is left in place; however, the sewers are plugged as part of the human health alternative. The contamination associated with the sewers is present between 6 and 10 ft below the ground surface. As such, the contaminated soils pose a low long-term threat to biota. Furthermore, the linear nature of the sewer lines prevent habitat modifications and exclusion practices from being practicable. The preferred alternative for the Lake Sediments Medium Group is B1a:

Caps/Covers (Clay/Soil Cap) with Consolidation; No Additional Action (Provisions of FFA) (Table 20.1-3). This alternative entails excavating the 51,000 BCY more contaminated soils from the inlets of the lakes, which are human health exceedances, and consolidating these contaminated soils to Basin A for containment. These exceedances are near the inlets to the lakes and can be reached with conventional earthmoving equipment after the installation of a cut-off wall. Under the first part of the alternative, these sediments are excavated, dewatered, and transported to Basin A for containment. The remaining exceedance volume is left in place under the no action part of the alternative. The consolidation of soils for containment reduces the areas requiring long-term management and maintenance and restoration of the wetlands increases the areas available for use as habitat.

20.4 POTENTIAL AGENT PRESENCE CATEGORY

This subsection summarizes the preferred alternatives for areas potentially containing agent (Figure 20.4-1). The bulk of the area with the potential for agent is located in the eastern portion of RMA and in parts of Section 36. Agent contamination also exists in North and South Plants. The preferred alternatives for the remediation of agent contamination consist of containing the areas of potential agent presence in conjunction with the clay/soil cap for the human health exceedance areas or screening the areas for the presence of agent and treating the identified agent-contaminated soils by rotary kiln incineration. Table 20.1-2 presents the preferred alternative for both subgroups within the Agent Storage Medium Group.

20.4.1 Clay/Soil Cap

Only those areas with potential agent presence in the Basin A, South Plants Central Processing Area, and Section 36 Lime Basins Subgroups are screened during the excavation of the principal threat volume. These areas are contained by the installation of a clay/soil cap (Alternative A2: Caps/Covers). Approximately 250,000 SY of potentially agent-contaminated soils are capped in place in the Complex Trenches Subgroup and are therefore not screened for agent. The remaining portions of this subgroup are screened for agent and any identified agent-contaminated soils are treated by rotary kiln incineration (Figure 20.4-1).

20.4.2 Rotary Kiln Incineration

Alternative A4: Incineration/Pyrolysis (Rotary Kiln) is the preferred alternative for the remaining soils containing agent. The potential agent presence areas (630,000 SY) are screened and the agent-contaminated soils are treated in a rotary kiln incinerator. This alternative is a thermal treatment alternative for soils containing agents that achieve 5X decontamination criteria (AMC-R 385-131) which includes performing real-time screening prior to excavation to identify areas with agent. Section 7.2 of the Technology Description Volume discusses the preparation of a rotary kiln incinerator. The treated soils are backfilled on site, but the organic carbon content of the soils is destroyed during rotary kiln incineration. As such, topsoil is placed over the backfilled areas and revegetated with native grasses in accordance with a refuge management plan.

20.5 POTENTIAL UXO PRESENCE CATEGORY

Figure 20.5-1 summarizes the preferred alternatives for the areas potentially containing UXO, and the following subsections discuss the alternatives selected for potential UXO presence areas. Most areas with the potential presence of UXO are first cleared for UXO and any identified UXO demilitarized off-post as discussed in Table 20.1-1 for the Munitions Testing Medium Group.

20.5.1 Caps/Covers

The area with potential UXO presence in Basin A (130,000 SY) is not cleared since it is contained in the cap that is being placed on Basin A. Approximately 140,000 SY of soils potentially containing UXO are capped in place in the Complex Trenches Subgroup and are therefore not screened for UXO. The remaining portions of this subgroup are cleared for UXO and any identified UXO demilitarized off post (Figure 20.5-1).

20.5.2 Off-Post Detonation/Incineration

The preferred alternative for the remaining areas with potential UXO presence is off-post demilitarization of UXO at an existing Army Facility. The areas with the potential for UXO are cleared using geophysical methods (1,000,000 SY) prior to excavation. The UXO are then excavated, packaged, and transported to an off-post Army facility for incineration. Agent-filled UXO is identified during clearance operations for the Complex Trenches and Section 36 Balance

of Areas subgroups. Agent-filled UXO is transported to an off-post Army facility specially designed for the incineration and detonation of agent-filled munitions. For the Munitions Testing, Burial Trenches, and South Plants Balance of Areas Medium Group/Subgroups, HE-filled UXO are anticipated to be encountered. These UXO are transported to an off-post Army Facility for detonation. During clearance and excavation of UXO, 220,000 BCY of surface soils and metallic debris are scraped from the areas and placed in the on-post landfill.

20.6 MEDIA INTERACTIONS

The remedial alternatives developed for the soils medium impact those developed for the water and structures media. The major interactions between the soils and structures media consist of demolishing structures and removing the resulting debris to allow access to the underlying soils. Coordination is required between the soils and groundwater media to evaluate if the dewatering systems for soils can be incorporated into groundwater pump-and-treat systems. Also, the preferred soils alternatives for Basin A and South Plants enhance the operation of groundwater dewatering systems.

In the South Plants Central Processing Area, the structures need to be demolished and removed to allow the treatment of the principal threat volume. However, soils and structures remedial activities can be coordinated such that the uncontaminated structural debris can be stockpiled near the site and placed under the clay/soil cap for the South Plants Central Processing Area, and the estimated 200,000 BCY of contaminated structural debris can be placed beneath the cap as grading fill and still maintain the design grades for the clay/soil cap. Furthermore, alternatives developed for the structures medium involve the use of borrow material as backfill once the building foundations and basements are removed. Instead of using this borrow material, consolidated soils from the other parts of South Plants could be used for this backfill, which would result in the placement of a larger volume of structural debris beneath the cap. The structural debris from South Plants and other areas could also be consolidated in Basin A.

Dewatering systems are required for the safe excavation of the Shell Trenches and portions of the Section 36 Balance of Areas Subgroups. These Systems will be in operation between 3 and

5 years but produce less than 5 gpm, which will be treated by the CERCLA Wastewater Treatment Plant. As such, the operation of these systems does not preclude the use of the CERCLA Wastewater Treatment Facility for other groundwater pump-and-treat systems evaluated in the Water DAA. The preferred alternative for the Basin A Plume Group consists of a mass-reduction system in Basin A and along the eastern side of the basin. This system could be expanded to include the excavation dewatering systems. The containment of the Complex Trenches entails long-term hydraulic controls to create and maintain inward gradients; however, this system is anticipated to generate less than 1 gpm, which would not impact the operation of the CERCLA Wastewater Treatment Plant.

The preferred alternative for groundwater in the Basin A Plume Group (Section 36 Areas) is mass reduction combined with air stripping and GAC adsorption. The preferred alternative for soils in this area (Alternative 6f: Direct Thermal Desorption of Principal Threat Volume; Caps/Covers) enhances the effectiveness of the groundwater alternative by reducing groundwater recharge and contaminant leaching. The preferred alternative for soils for the South Plants Central Processing Area Subgroup (Alternative 6a: Direct Thermal Desorption and Direct Solidification/Stabilization of Principal Threat Volume; Caps/Covers) complements the groundwater preferred alternative—mass reduction and cap installation over the Central Processing Area. Furthermore, the preferred soils alternative for the South Plants Tank Farm Subgroup (Alternative l6a: In Situ Physical/Chemical Treatment) does not interfere with the in situ biodegradation alternative selected for the South Plants Tank Farm Plume.

20.7 FACILITY SIZING

As discussed in Section 3.1, centralized facilities were evaluated for thermal desorption, rotary kiln incineration, and landfilling. These facilities were sized based on the largest volume of contaminated soil that might be processed by the facility if the alternatives using the particular facility were selected for every medium group to which they applied. The following paragraphs discuss modifications to the sizing of these facilities based on the volumes of contaminated soils associated with the preferred alternatives. For example, the centralized landfill was sized at 6.0 million BCY in order to accommodate all soils and debris from the landfill alternatives evaluated

for the soils and structures media, but the volume of soil and debris to be placed in the centralized landfill based on the preferred alternatives is 1.0 million BCY. The resized facilities area is used to develop adjusted unit costs for the preferred alternatives.

20.7.1 Thermal Desorption

The thermal desorption facility used to detail alternatives consisted of two 37-ton/hr desorbers as discussed in Section 4.6.23. This facility was sized to treat 3.1 million BCY of contaminated soils within 10 years and would have required nearly 20 years to treat the approximately 6.0 million BCY of contaminated soils that would have been processed if full thermal desorption alternatives were selected for all medium groups to which thermal desorption applied. Based on the preferred alternatives, the estimated volume of soil to be thermally desorbed is 620,000 BCY. This lower volume allows for a decrease both in facility size and remediation time. A 40-ton/hr thermal desorber would be capable of processing the 620,000 BCY within slightly over 4 years. Two options are available for the thermal desorption facility: a single-train, 40-ton/hr thermal desorption unit could be constructed at RMA, or a leased 40-ton/hr mobile desorber could be located on site.

The construction and testing of a 40-ton/hr thermal desorber would require 2 years. The unit capital cost for the construction of the smaller unit would be up to twice as high as the 74-ton/hr facility evaluated, since fixed capital costs for construction are amortized over a much smaller treatment volume. Some of the construction costs (e.g. rotary dryer construction) for thermal desorption are variable depending on the size of the thermal desorber, but other costs, such as the soils handling system, are fixed. These fixed costs represent a higher unit cost when smaller volumes are treated. The unit operating cost would be essentially the same as for the 74-ton/hr facility at between $49.00/BCY and $74.00/BCY depending on the moisture content of the solids feed (Appendix B). The startup time required for a leased thermal desorber is 1 year. The unit operating costs for a mobile facility would be 25 to 40 percent higher (approximately $94.00/BCY) than for the 74-ton/hr facility since the operating costs for mobile thermal desorbers includes amortization of the construction cost. Although the capital costs of mobilization and demobilization of a transportable unit are much lower than construction costs of a comparably

sized fixed facility, the unit capital cost for a transportable thermal desorber ($34.85/BCY) are higher than for the 74-ton/yr facility since the costs are amortized over a smaller volume. The total cost for the mobile thermal desorption facility would probably be lower than for the construction of a 40 ton/hr desorber, and several mobile thermal desorption units are available as discussed in Section 7.1 of the Technology Description Volume. A 40 ton/hour transportable thermal desorber is used for the adjustment of unit costs.

20.7.2 Incineration

The initial cost estimate for the centralized incineration facility was based on treating the estimated 600,000 BCY of soil and debris that would have been processed if incineration were selected for all medium groups, an amount that requires the use of a single 28-ton/hr rotary kiln. Based on the preferred alternatives, the volume of soil and debris to be incinerated is 110,000 BCY; therefore, a 28-ton/hr rotary kiln is oversized for the treatment requirements. The treatment time for this 110,000 BCY would be less than 1 year (after 2 years of construction and startup). A 20-ton/hr mobile rotary kiln incinerator would be adequate for treating the contaminated soils and debris within approximately 2 years. The overall remediation time for a 20-ton/hr rotary kiln incinerator would also be 3 years, since the start up of the mobile incinerator is 1 year. As with the mobile thermal desorption facility, the capital cost would be less than the capital cost of constructing the 28-ton/hr rotary kiln since the capital cost for a mobile unit is the mobilization/demobilization fee, but the unit Capital Cost ($72.00/BCY) is higher based on the smaller volume. The unit operating cost for a mobile rotary kiln incinerator (approximately $201.00/BCY) would be up to 50 percent higher than for the constructed 28-ton/hr unit. The higher operating cost for a mobile unit represents the amortization of the construction cost of the mobile unit. Mobile rotary kilns are widely available as discussed in Section 7.2 of the Technology Description Volume. A 20-ton/hr transportable rotary kiln incinerator is used to develop adjusted unit costs.

20.7.3 Landfill

The on-post landfill was sized to contain a total of 6.0 million BCY of contaminated soils and debris in four 1.5 million-CY cells (assuming that all of the landfilling alternatives would be

selected). However, based on the preferred alternatives, the volume of soil and debris that is to be landfilled is 1.0 million BCY; thus the size of the landfill facility can be reduced. The landfill will now consist of four 250,000-CY cells. The dimensions of the 250,000-CY landfill cells are 500 ft square with a depth of 35 ft. The sideslopes are the same as for the 1.5 million-CY cells evaluated in Section 6.6 of the Technology Description Volume. The four 250,000-CY cells are to be constructed in accordance with the RCRA hazardous waste landfill requirements, which are also discussed in Section 6.6 of the Technology Description Volume. The unit operating and long-term maintenance costs would be essentially the same for both the 250,000- and 1.5 million-CY cells, but the unit construction cost for a 250,000 CY cell (approximately $12.00/BCY) would be less than 10 percent higher than the higher cost for the construction of a 250,000 CY cell and a 1.5 million-CY cell since cost is based on the economies of scale resulting from larger landfill cells.

During the evaluation of alternatives, both solid waste and hazardous waste landfills were considered. Debris collected during the clearance of areas with potential UXO presence was considered as being placed in a solid waste cell during the costing of alternatives. However, since the cost for constructing a hazardous waste cell is less than 40 percent higher than for a solid waste cell (Appendix B), the debris for UXO clearance is to be placed in the hazardous waste landfill cell.

The downsized centralized landfill can be moved to the northern portion of Site CSA-1d (Sanitary Landfills Medium Group) in order to minimize the disturbance of habitat outside of contaminated areas. The preferred alternative for this site is excavating the contaminated soil and debris and disposing of them in a landfill. As such, the 56,000 BCY of contaminated soil would be excavated and stockpiled during the construction of the landfill. This area has been evaluated as a landfill area in previous studies. This location will achieve the location- and action- specific ARARs for a hazardous waste landfill. The location is also within the primary area selected for a centralized landfill based on the citing criteria developed for locating the 6.0 million-CY landfill (Section 6.6 of Technology Description Volume).

20.7.4 Summary of Adjusted Costs

The reduction in size for the thermal desorption, rotary kiln incineration and centralized landfill facilities changes the unit costs and these adjusted unit costs are used to develop the estimated total cost of the preferred alternatives. As discussed in previous sections, large volumes of low-level contamination are addressed by capping and consolidation. The unit costs for capping and consolidation do not require modifications for the volumes of contaminated soils associated with the preferred alternatives. The unit cost for access restrictions for the Sanitary/Process Water Sewers Subgroup are adjusted since the public education programs will only be applicable to that subgroup.

The total present worth cost for the preferred soils alternatives is $530 million, and the total cost without a present worth discount, is $610 million (Table 20.1-16). Approximately 57 percent of these costs are direct costs, with the remaining 43 percent comprised of indirect costs of mobilization/demobilization, engineering design, resident engineering, field indirects, and overhead and profit. The mobilization/demobilization costs for the preferred alternatives consist of 1.3 percent of the present worth costs, and an overall contingency of 24 percent is applied to the total present worth costs.

A cost sensitivity analysis has been performed for the preferred alternatives following the adjustment of unit costs due to uncertainties relative to exceedance volume estimates and assumptions regarding the design, operation, implementation, and duration of remedial alternatives. Since the accuracy of cost estimates for the DAA is expected to be within +50 to -30 percent, the exceedance volumes and unit costs are each increased 50 percent and decreased 30 percent as part of the cost sensitivity analysis. The unit costs for direct treatment technologies (e.g. thermal desorption and incineration), off-post detonation/incineration of UXO and excavation of disposal trenches exhibit much larger uncertainties regarding design, operation, and duration assumptions than the other unit costs, such as backfilling and capping. As such, the +50 and -30 percent factors are applied to these three groups of unit costs. The estimated present worth cost of remedial alternatives for the soils medium is between $430 million and $690 million with an estimated present worth cost of $530 million, as detailed in Table 20.7-1.

20.8 SCHEDULING OF REMEDIAL ALTERNATIVES FOR SOILS

Based on the adjusted processing rates for thermal desorption and incineration discussed in Section 20.7, the time frame required for implementation of the soils remedial alternatives is approximately 10 years, assuming that funding will not limit alternative implementation for either construction or operation activities. It should be noted that the processing rates and alternative durations were developed for the evaluation of alternatives and do not represent a specific evaluation of the optimal interactions between alternative components. The following paragraphs discuss several issues relative to the duration of remedial actions at RMA.

The operation of the 40-ton/hr transportable thermal desorber covers a period of 4 to 5 years based on the volume to be treated of 620,000 BCY. In order to allow the consolidation of 1,100,000 BCY of soils into Basin A for containment, early in the process, the principal threat exceedance volume of 4,600 BCY from Basin A would be treated first by the thermal desorption unit. The principal threat exceedances in the Former Basin F would then be treated in order to allow an additional 1-1/2 years for the demolition of structures in South Plants and the removal of the resulting debris. The remainder of the 4 to 5 year duration for the operation of the thermal desorber would entail the treatment of principal threat exceedances from South Plants, including the chemical sewers (47,000 BCY) within South Plants.

Since the operation of the thermal desorber generates a solid sidestream of entrained particulates and evaporated salts from the wet scrubber, the operation of the centralized landfill is contrained to match the 4 to 5 year time frame for thermal desorption. The rate of generating this sidestream from thermal desorption is much less than the daily operations rate of the centralized landfill, which allows the disposal of the contaminated soils and debris within the same time frame.

The 33,000 BCY of soils to be treated by solidification/stabilization can be addressed in 3 years. The processing rate for solidification/stabilization was developed in order for the duration of solidification/stabilization to match the duration of thermal desorption. The 3 year duration for solidification/stabilization fits within the 4 to 5 year duration for thermal desorption and closely

matches the time frame required for thermal desorption of contaminated soils from South Plants.

The operation of the rotary kiln incinerator is estimated to entail between 1 and 2 years, based on the 20 tons/hour throughput of the transportable incinerator used to adjust unit costs. The incinerator will primarily be used to treat soils and debris from the Shell Trenches and Hex Pit Subgroups, but is also to be used to treat soils containing agent. As a result, the rotary kiln incinerator could be operated during the same timeframe as thermal desorption and solidification/stabilization, or the incinerator could be operated later with the soils identified as containing agent being contained until the incinerator is brought on line.

Table 20.1-1 Summary of Preferred Alternative for Munitions Testing Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Munitions Testing	CSA-2c CSA-2d ESA-1a ESA-1b ESA-1c ESA-1d ESA-4a ESA-4b	U1: No Additional Action (Provisions of FFA) U2: Caps/Covers (Clay/Soil Cap) U3: Incineration/Pyrolysis (Rotary Kiln) U4a: Detonation (Off-Post Army Facility)	UXO Alt. U4a: Detonation (Off-Post Army Facility) Clearance of areas with potential UXO. Excavation and transport of HE-filled UXO to off-post facilities for detonation. Excavation and disposal of metallic debris in an on-post landfill.	Achieves threshold criteria; cost effective due to small volume of anticipated UXO (450 BCY); uses existing Army treatment facilities.

Table 20.1-2 Summary of Preferred Alternatives for Agent Testing Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
North Plants	NPSA-3 NPSA-5 NPSA-6 Building 1601 Building 1606 Building 1607	A1: No Additional Action (Provisions of FFA) A2: Caps/Covers (Clay/Soil Cap) A3: Soil Washing (Solution Washing); Landfill (On-Post Landfill) A4: Incineration/Pyrolysis (Rotary Kiln) A5: Direct Soil Washing (Solvent Washing); Landfill (On-Post Landfill)	Agent Alt. A4: Incineration/Pyrolysis (Rotary Kiln) Agent screening for areas with potential agent presence and rotary kiln incineration of agent-contaminated soils. Disposal of treated soils and isolated human health and biota exceedances in an on-post landfill.	Achieves threshold criteria; cost-effective alternative as residuals not generated during treatment and isolated human health and biota exceedances placed in landfill; achieves DOD criteria for Army agent; eliminates long-term maintenance and liability; permanent solution.

Table 20.1-2 Summary of Preferred Alternatives for Agent Testing Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Toxic Storage Yards	ESA-3a ESA-3b ESA-3c ESA-3d ESA-3e ESA-3f ESA-3g ESA-3h ESA-3i	A1: No Additional Action (Provisions of FFA) A2: Caps/Covers (Clay/Soil Cap) A3: Soil Washing (Solution Washing); Landfill (On-Post Landfill) A4: Incineration/Pyrolysis (Rotary Kiln) A5: Direct Soil Washing (Solvent Washing); Landfill (On-Post Landfill)	Agent Alt. A4: Incineration/Pyrolysis (Rotary Kiln) Agent screening for areas with potential agent presence and rotary kiln incineration of agent-contaminated soils. Disposal of treated soils and isolated human health and biota exceedances in an on-post landfill.	Achieves threshold criteria; cost-effective alternative as residuals not generated during treatment and isolated human health and biota exceedances placed in landfill; achieves DOD criteria for Army agent; eliminates long-term maintenance and liability; permanent solution.

Table 20.1-3 Summary of Preferred Alternative for Lake Sediments Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Lake Sediments	NCSA-7 SSA-1b SSA-1c SSA-1e SSA-5b	B1: No Additional Action (Provisions of FFA) B1a: Caps/Covers (Clay/Soil Cap) with Consolidation; No Additional Action (Provisions of FFA) B3: Landfill (On-Post Landfill) B6: Direct Thermal Desorption (Direct Heating) B10: Caps/Covers (Clay/Soil Cap) with Consolidation; In Situ Biological Treatment (Aerobic Biodegradation)	Biota Alt. B1a: Caps/Covers (Clay/Soil Cap) with Consolidation; No Additional Action (Provisions of FFA) Excavation and consolidation of highest levels of contamination, which consist of human health exceedances, in Basin A as grading fill prior to capping of Basin A. Monitoring continued and 5-year site reviews initiated for remainder of sediments.	Achieves threshold criteria; cost-effective alternative as the small volume (51,000 BCY) of highest contamination removed from the lake inlets and consolidated in Basin A; lower destruction of aquatic habitat; consistent with NCP guidance on use of engineering and institutional controls for lower levels of contamination.

Table 20.1-4 Summary of Preferred Alternative for Surficial Soils Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Surficial Soils	NCSA-1g Surficial Soils Survey	B1: No Additional Action (Provisions of FFA) B3: Landfill (On-Post Landfill) B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) B11: In Situ Thermal Treatment (Surface Soil Heating)	Biota Alt. B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) In situ treatment of biota exceedances in shallow soils by landfarm/agricultural practice. No action undertaken for isolated human health exceedance due to the high-value habitat associated with this exceedance area (Bald Eagle Roost Exclusion Area).	Achieves threshold criteria; cost-effective alternative due to large exceedance volume (810,000 BCY); lower impact on habitat as soils not damaged during remediation and are revegetated more readily.

Table 20.1-5 Summary of Preferred Alternative for Ditches/Drainage Areas Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Ditches/ Drainage Areas	CSA-2b ESA-6c NCSA-1d NCSA-1c NCSA-1f NCSA-2d NCSA-5d NCSA-8b NPSA-8c NPSA-9f SSA-2a SSA-2c WSA-1f	B1: No Additional Action (Provisions of FFA) B2: Biota Management (Exclusion, Habitat Modification) B3: Landfill (On-Post Landfill) B5a: Caps/Covers (Clay/Soil Cap) with Consolidation B6: Direct Thermal Desorption (Direct Heating) B9: In Situ Biological Treatment (Landfarm/Agricultural Practice)	Biota Alt. B5a: Caps/Covers (Clay/Soil Cap) with Consolidation Excavation of biota exceedances and consolidation in Basin A as grading fill prior to capping of Basin A.	Achieves threshold criteria; cost-effective alternative as soils consolidated prior to containment; consistent with NCP guidance on containment for low levels of contamination.

Table 20.1-6 Summary of Preferred Alternative for Basin A Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Basin A	NCSA-1a NCSA-1e	1: No Additional Action (Provisions of FFA) 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap) 6f: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) 8: Direct Soil Washing (Solvent Washing); Direct Solidification/Stabilization (Cement-Based Solidification) 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification) 17: In Situ Physical/Chemical Treatment (Soil Flushing); In Situ Thermal Treatment (Surface Soil Heating) 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification)	Human Health Alt. 6f: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) Biota Alt. B5: Caps/Covers (Clay/Soil Cap) Agent Alt. A2: Caps/Covers (Clay/Soil Cap) Agent Alt. U2: Caps/Covers (Clay/Soil Cap) Direct thermal desorption of principal threat volume and containment of remaining exceedance areas. Soil cap contains Basin A soils and soils from other medium groups consolidated as grading fill.	Achieves threshold criteria; cost-effective alternative due to relatively small principal threat volume (4,600 BCY compared to total exceedance volume; consistent with NCP guidance on treatment for higher levels of contamination; lower short-term impacts as only principal threat volume excavated; potential agent and UXO areas are within area to be capped and consequently do not require a separate cover.

Shading denotes alternative differs in some aspect from alternative retained in the DSA or was not retained in DSA and has been reintroduced into the DAA.

Note: Alternative 9: Direct Solution Washing; Direct Thermal Desorption: Direct Solidification/Stabilization was not evaluated in the DAA since this alternative was retained for treatment of fluoroacetic acid, which is not considered in exceedance volumes for the DAA.

Table 20.1-7 Summary of Preferred Alternative for Basin F Wastepile Medium Group

Subgroup Name	Site	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Basin F Wastepile	Basin F Wastepile	1: No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA) 6e: Caps/Covers (Composite Cap) 8a: Direct Soil Washing (Solvent Washing) 9a: Direct Soil Washing (Solution Washing); Direct Thermal Desorption (Direct Heating) 13a: Direct Thermal Desorption (Direct Heating)	Human Health Alt. 6e: Caps/Covers (Composite Cap) Installation of composite cap over Basin F Wastepile as final cover. Correction of leachate collection problems in sump of cell #2	Achieves threshold criteria based on enhanced containment; cost-effective alternative due to improvement of IRA containment system; lower short-term impacts as no excavation required.

Shading denotes alternative differs in some aspect from alternative retained in the DSA or was not retained in the DSA and has been reintroduced into the DAA.

Table 20.1-8 Summary of Preferred Alternatives for Secondary Basins Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Secondary Basins	NCSA-2a, Basin C NCSA-2b, Basin D NCSA-5a, Basin B	1: No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA) 6: Caps/Covers (Clay/Soil Cap) 6g: Caps/Covers (Clay/Soil Cap) with Consolidation 13a: Direct Thermal Desorption (Direct Heating) 19a: In Situ Thermal Treatment (RF/Microwave Heating)	Human Health Alt. 6g: Caps/Covers (Clay/Soil Cap) with Consolidation Biota Alt. B5a: Caps/Covers (Clay/Soil Cap) with Consolidation Excavate and consolidate human health and biota exceedance areas within Basin A for capping.	Achieves threshold criteria; cost-effective alternative due to consolidation of soils in Basin A for containment; consistent with NCP guidance on containment for lower levels of contamination; short-term impacts during consolidation are not a significant problem due to low levels of contamination.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Note: Alternative 9: Direct Soil Washing; Direct Thermal Desorption was not evaluated in the DAA since this alternative was retained in the DAA for the treatment of fluoroacetic acid, which is not considered in developing exceedance volumes in the DAA.

Table 20.1-8 Summary of Preferred Alternatives for Secondary Basins Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Former Basin F	NCSA-3, Former Basin F	1: No Additional Action (Provisions of FFA) 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA) 2a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Access Restrictions (Modifications to FFA) 6c: Direct Thermal Desportion (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Modifications to Existing System 6d: Caps/Covers (Clay/Soil Cap) with Modifications to Existing System 13a: Direct Thermal Desorption (Direct Heating) 19a: In Situ Thermal Treatment (RF/Microwave Heating)	Human Health Alt. 6c: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/ Covers (Clay/Soil Cap) with Modifications to Existing System Biota Alt. B5b: Caps/Covers (Clay/Soil Cap) with Modifications to Existing System Excavation and direct thermal desorption of principal threat volume. Augment existing cap with additional clay/soil cap. Consolidation of soils from other sites as grading fill to form a crown on the existing cap.	Achieves threshold criteria; cost-effective alternative due to large exceedance volume and relatively small principal threats volume (220,000 BCY); consistent with NCP guidance on treatment for higher levels of contamination; lower short-term impacts as only principal threat volume excavated; long-term performance of cap improved.

Table 20.1-8 Summary of Preferred Alternatives for Secondary Basins Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Basin F Exterior	NCSA-4a, Deep Well NCSA-4b, Basin F Exterior	1: No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA) 6: Caps/Covers (Clay/Soil Cap) 6g: Caps Covers (Clay/Soil Cap) with Consolidation 13a: Direct Thermal Desorption (Direct Heating) 19b: In Situ Thermal Treatment (RF/Microwave Heating, Surface Soil Heating)	Human Health Alt. 6g: Caps/Covers (Clay/Soil Cap) with Consolidation Biota Alt. B9: In Situ Biological Treatment (Landfarm/Agricultura l Practice) Consolidation of human health exceedance volumes within Basin A for capping. In situ treatment of biota exceedances in shallow soils by landfarm/agricultural practice.	Achieves threshold criteria; long-term improvement in habitat over large area (2,000,000 SY) with treatment of shallow soils; cost-effective alternative due to consolidation of soils in Basin A for containment; consistent with NCP guidance on containment of lower levels of contamination; short-term impacts during consolidation are not a significant problem due to low levels of contamination.

Table 20.1-9 Summary of Preferred Alternatives for Sewer Systems Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Sanitary/Process Water Sewers	NCSA-8a SPSA-11 SPSA-12 WSA-7a	1: No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA, Closure) 3: Landfill (On-Post Landfill) 13a: Direct Thermal Desorption (Direct Heating)	Human Health Alt. 2: Access Restrictions (Modifications to FFA, Closure) Biota Alt. B1: No Additional Action (Provisions of FFA) Implementation of excavation restrictions and plugging of sewer lines to reduce exposure pathways.	Achieves threshold criteria because contamination occurs at depth; cost-effective alternative based on depth of contamination and low levels of contamination; consistent with NCP guidance on controls for lower levels of contamination.
Chemical Sewers	CSA-3 NCSA-6a NCSA-6b NPSA-1 SPSA-10	1: No Additional Action (Provisions of FFA) 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA, Closure) 2a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Access Restrictions (Modifications to FFA, Closure) 3a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Landfill (On-Post Landfill) 8a: Direct Soil Washing (Solvent Washing) 13a: Direct Thermal Desorption(Direct Heating)	Human Health Alt. 3a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Landfill (On-Post Landfill) Agent Alt. A4: Incineration/Pyrolysis (Rotary Kiln) Agent screening during removal of sewer lines. Direct thermal desorption of principal threat volume and remaining soils contained in on-post landfill.	Achieves threshold criteria; cost-effective alternative as principal threat volume treated and remainder of sewer line contained in on-post landfill; consistent with NCP guidance on treatment of higher levels and engineering controls for lower levels of contamination.

Shading denotes alternative differs in some aspect from alternative retained in the DSA, or was not retained in the DSA and has been reintroduced into the DAA.

Table 20.1-10 Summary of Preferred Alternatives for Disposal Trenches Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Complex Trenches	CSA-1c	1: No Additional Action (Provisions of FFA) 5b: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Consolidation 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill)	Human Health Alt. 5b: Caps/Covers (Clay/ Soil Cap); Vertical Barriers (Slurry Walls) with Consolidation Biota Alt. B5a: Caps/Covers (Clay/ Soil Cap) with Consolidation Agent Alt. A2 and A4: Caps/Covers (Clay/Soil Cap) and Incineration/Pyrolysis (Rotary Kiln) UXO Alt. U2 and U4: Caps/Covers (Clay/Soil Cap) and Detonation (Off-Post Army Facility); Incineration/Pyrolysis (Off-Post Incineration) Containment of disposal trench anomalies with a clay/soil cap and slurry wall. Consolidation of biota and remaining human health exceedance volumes within isolation cells as grading fill.	Achieves threshold criteria; cost-effective alternative due to high cost and risks associated with treatment of high levels of contamination in trench materials mixed with debris, UXO, and agent-contaminated materials; lower short-term impacts as disposal trenches not excavated.

Table 20.1-10 Summary of Preferred Alternatives for Disposal Trenches Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
			Agent and UXO screening of consolidated soils only.	
Shell Trenches	CSA-1a	1: No Additional Action (Provisions of FFA) 5a: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) with Modifications to Existing System 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill)	Human Health Alt. 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) Excavation of site and treatment by rotary kiln incineration. Disposal of treated materials in on-post landfill. Vapor enclosure required during excavation. Backfill of excavation with borrow soil.	Achieves threshold criteria; consistent with NCP guidance on treatment of higher levels of contamination; eliminates long-term maintenance and monitoring; permanently reduces TMV.

Table 20.1-10 Summary of Preferred Alternatives for Disposal Trenches Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Hex Pit	SPSA-1f	1: No Additional Action (Provisions of FFA) 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill)	Human Health Alt. 14: Incineration/Pyrolysis (Rotary Kiln); Landfill (On-Post Landfill) Excavation of site and treatment by rotary kiln incineration. Disposal of treated materials in on-post landfill. Vapor enclosure required during excavation. Backfill of excavation with borrow soil.	Achieves threshold criteria; consistent with NCP guidance on treatment of higher levels of contamination; eliminates long-term maintenance and monitoring; permanently reduces TMV.

Table 20.1-11 Summary of Preferred Alternative for Sanitary Landfills Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Sanitary Landfills	CSA-1d ESA-2b SSA-4 WSA-2 WSA-3c WSA-5a WSA-5c WSA-5d	1: No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA) 3: Landfill (On-Post Landfill) 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) 13b: Direct Thermal Desorption (Direct Heating); Landfill (On-Post Landfill)	Human Health Alt. 3: Landfill (On-Post Landfill) Biota Alt. B3: Landfill (On-Post Landfill) Excavation and consolidation of human health and biota exceedance volumes in on-post landfill.	Achieves threshold criteria; consistent with NCP guidance on engineering controls for low levels of contamination; long-term management and maintenance reduced compared to the caps/covers; vertical barriers alternative.

Table 20.1-12 Summary of Preferred Alternatives for Lime Basins Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Section 36 Lime Basins	NCSA-1b	1: No Additional Action (Provisions of FFA) 6d: Caps/Covers (Clay/Soil Cap) with Modifications to Existing System 13a: Direct Thermal Desorption (Direct Heating) 19a: In Situ Thermal Treatment (RF/Microwave Heating)	Human Health Alt. 6d: Caps/Covers (Clay/Soil Cap) with Modifications to Existing System Biota Alt. B5b: Caps/Covers (Clay/Soil Cap) with Modifications to Existing System Agent Alt. A2: Caps/Covers (Clay/Soil Cap) Augment existing cap with additional clay/soil cap.	Achieves threshold criteria; cost-effective alternative as existing containment system augmented; long-term performance of cap improved with additional layers.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-12 Summary of Preferred Alternatives for Lime Basins Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Buried M-1 Pits	SPSA-1e	1: No Additional Action (Provisions of FFA) 5: Caps/Covers (Clay/Soil Cap); Vertical Barriers (Slurry Walls) 10: Direct Solidification/Stabilization (Cement-Based Solidification) 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification) 21: In Situ Thermal Treatment (In Situ Vitrification)	Human Health Alt. 10: Direct Solidification/ Stabilization (Cement-Based Solidification) Agent Alt. A4: Incineration/ Pyrolysis (Rotary Kiln) Agent screening of site prior to excavation and incineration of identified soils containing agent. Excavation and cement-based solidification of soils above human health exceedances. Backfill excavation with solidified mass and cover with vegetative soil cover to prevent degradation.	Achieves threshold criteria; consistent with NCP guidance on treatment of higher levels of contamination; cost-effective alternative due to high levels of arsenic and mercury; reduces long-term monitoring and maintenance; significantly reduces TMV.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-13 Summary of Preferred Alternatives for South Plants Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
South Plants Central Processing Area	SPSA-1a: Central Processing Area	1: No Additional Action (Provisions of FFA) 1b: Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; No Additional Action (Provisions of FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap) 6a:Direct Thermal Desorption (Direct Heating) and Direct Solidification/Stabilization (Cement-Based Solidification) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification) 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification)	Human Health Alt. 6a: Direct Thermal Desorption (Direct Heating) and Direct Solidification/ Stabilization (Cement-Based Solidification) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) Biota Alt. B5: Caps/Covers (Clay/Soil Cap) Agent Alt. A2: Caps/Covers (Clay/Soil Cap)	Achieves threshold criteria; cost-effective alternatives due to small principal threat volume (320,000 BCY) compared to exceedance volume; consistent with NCP guidance on treatment for higher levels of contamination; lower short-term impacts as only principal threat volume excavated; structures demolished but only removed in principal threat areas.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-13 Summary of Preferred Alternatives for South Plants Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
			Direct thermal desorption and cement-based solidification of principal threat volume and containment of remaining exceedance areas. Clay/soil cap contains soils and debris from site plus consolidated soils and structural debris from other portions of South Plants as grading fill beneath cap.	
South Plants Ditches	SPSA-1d SPSA-2d SPSA-3a SPSA-4a SPSA-5a SPSA-8b SPSA-9a	1: No Additional Action (Provisions of FFA) 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap) 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation 13a: Direct Thermal Desorption (Direct Heating)	Human Health Alt. 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation Biota Alt. B5a: Caps/Covers (Clay/Soil Cap) with Consolidation	Achieves threshold criteria; cost-effective alternative as principal threat volume (6,300 BCY) smaller than exceedance volume; consistent with NCP guidance on treatment of high levels of contamination and engineering controls for lower levels of contamination; consolidation decreases long-term maintenance and management.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-13 Summary of Preferred Alternatives for South Plants Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
			Excavation and direct thermal desorption of principal threat volume. Consolidate remaining soils from ditches as grading fill within South Plants Central Processing Area prior to capping.	
South Plants Tank Farm	SPSA-2a SPSA-2b	1: No Additional Action (Provisions of FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap); 13a: Direct Thermal Desorption (Direct Heating) 16a: In Situ Physical/Chemical Treatment (Vacuum Extraction) 19a: In Situ Thermal Treatment (RF/Microwave Heating)	Human Health Alt. 16a: In Situ Physical/Chemical Treatment (Vacuum Extraction) Biota Alt. B9: In Situ Biological Treatment (Landfarm/Agricultural Practice) Removal of volatiles by in situ vacuum extraction. In situ treatment of shallow soils above biota levels by landfarm/agricultural practice.	Achieves threshold criteria; cost-effective alternative as volatiles are only Human Health COCs; consistent with NCP guidance on treatment of more mobile contaminants.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-13 Summary of Preferred Alternatives for South Plants Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
South Plants Balance of Areas	SPSA-1b SPSA-1c SPSA-1g SPSA-2c SPSA-2e SPSA-3b SPSA-3c SPSA-3d SPSA-3e SPSA-4b SPSA-5b SPSA-7b SPSA-7c SPSA-8a SPSA-9b SPSA-12a SPSA-12b	1: No Additional Action (Provisions of FFA) 1a: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; No Additional Action (Provisions of FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap) 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification) 19: In Situ Thermal Treatment (RF/Microwave Heating); In Situ Solidification/Stabilization (Cement-Based Solidification) 20: In Situ Thermal Treatment (Surface Soil Heating); Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification)	Human Health Alt. 6b: Direct Thermal Desorption (Direct Heating) of Principal Threat Volume; Caps/Covers (Clay/Soil Cap) with Consolidation Biota Alt. B5a: Caps/Covers (Clay/Soil Cap) with Consolidation Agent Alt. A4: Incineration/Pyrolysis (Rotary Kiln) UXO Alt. U4a: Detonation (Off-Post Army Facility) Agent screening and UXO clearance of site prior to excavation. Excavation and direct thermal desorption of principal threat volume. Consolidation of remaining soils and debris and containment within South Plants Central Processing Area prior to capping.	Achieves threshold criteria; cost-effective alternative because of small principal threat volume (19,000 BCY) compared to the exceedance volume; consistent with NCP guidance on treatment for higher levels of contamination; reduced long-term maintenance and management through consolidation with cap in the Central Processing Area.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-14 Summary of Preferred Alternatives for Buried Sediments/Ditches Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Buried Sediments	SSA-3a SSA-3b	1: No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap) 6g: Caps/Covers (Clay/Soil Cap) with Consolidation 13a: Direct Thermal Desorption (Direct Heating) 19a: In Situ Thermal Treatment (RF/Microwave Heating)	Human Health Alt. 6g: Caps/Covers (Clay/Soil Cap) with Consolidation Biota Alt. B5a: Caps/Covers (Clay/Soil Cap) with Consolidation Excavation and consolidation of biota and human health volume in Basin A.	Achieves threshold criteria; cost-effective alternative due to consolidation of contaminated soils in Basin A for containment; consistent with NCP guidance on engineering controls for lower levels of contamination; long-term management and maintenance reduced through consolidation with capping in Basin A.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-14 Summary of Preferred Alternatives for Buried Sediments/Ditches Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Sand Creek Lateral	NCSA-5b NCSA-5c NPSA-4 SSA-2b WSA-6a	1: No Additional Action (Provisions of FFA) 3: Landfill (On-Post Landfill) 6g: Caps/Covers(Clay/Soil Cap) with Consolidation 13a: Direct Thermal Desorption (Direct Heating)	Human Health Alt. 6g: Caps/Covers (Clay/Soil Cap) with Consolidation Biota Alt. B5a: Caps/Covers (Clay/Soil Cap) with Consolidation Excavation and consolidation of biota and human health volume in Basin A.	Achieves threshold criteria; cost-effective alternative due to consolidation of contaminated soils in Basin A for containment; consistent with NCP guidance on engineering controls for lower levels of contamination; long-term management and maintenance reduced through consolidation with capping in Basin A.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-15 Summary of Preferred Alternatives for Undifferentiated Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Section 36 Balance of Areas	CSA-1b CSA-2a CSA-4	1: No Additional Action (Provisions of FFA) 2: Access Restrictions (Modifications to FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap) 6g: Caps/Covers (Clay/Soil Cap) with Consolidation 13a: Direct Thermal Desorption (Direct Heating) 19a: In Situ Thermal Treatment (RF/Microwave Heating)	Human Health Alt. 6g: Caps/ Covers (Clay/Soil Cap) with Consolidation Biota Alt. B5a: Caps/Covers (Clay/Soil Cap) with Consolidation Agent Alt. A4: Incineration/Pyrolysis (Rotary Kiln) UXO Alt. U4: Detonation (Off-Post Army Facility) Incineration/Pyrolysis (Off-Post Incineration) Agent screening and UXO clearance of site prior to excavation. Consolidation of human health and biota exceedance areas in Basin A for containment.	Achieves threshold criteria; cost-effective alternative due to consolidation of contaminated soils in Basin A for containment; consistent with NCP guidance on engineering controls for lower levels of contamination; long-term maintenance and management reduced through consolidation.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-15 Summary of Preferred Alternatives for Undifferentiated Medium Group

Subgroup Name	Sites	Evaluated Alternatives	Preferred Alternative	Rationale for Selection of Alternative
Burial Trenches	ESA-2a ESA-2c	1: No Additional Action (Provisions of FFA) 3: Landfill (On-Post Landfill) 6: Caps/Covers (Clay/Soil Cap) 10: Direct Solidification/ Stabilization (Cement-Based Solidification) 13: Direct Thermal Desorption (Direct Heating); Direct Solidification/Stabilization (Cement-Based Solidification)	Human Health Alt. 3: Landfill (On-Post Landfill) Biota Alt. B3: Landfill (On-Post Landfill) Agent Alt. A4: Incineration/Pyrolysis (Rotary Kiln) UXO Alt. U4a: Detonation (Off-Post Army Facility) Agent screening and UXO clearance of site. Contaminated soils excavated and contained in on-post landfill.	Achieves threshold criteria; cost-effective alternative due to characteristics of soils with low levels of contamination and debris consistent with NCP guidance on engineering controls for low levels.

Shading denotes alternative differs in some aspect from alternative retained in the DSA.

Table 20.1-16 Summary of Preferred Alternatives

Medium/Subgroup Group	Preferred Alternative	Adjusted Cost (in Millions)	Adjusted Present Worth Cost (in Millions)
Human Health			
Basin A	Alternative 6f: Direct Thermal Desorption of principal threat volume; Installation of Caps/Covers over entire exceedance area.	$56	$39
Basin F Wastepile	Alternative 6e: Installation of Caps/Covers over entire exceedance area.	$12	$9.2
Secondary Basins	Alternative 6g: Consolidation of exceedance area in Basin A; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$12	$12
Former Basin F	Alternative 6c: Direct Thermal Desorption of principal threat volume; Installation of additional layers of Caps/Covers augmenting existing cap.	$98	$82
Basin F Exterior	Alternative 6g: Consolidation of exceedance area in Basin A; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$6.0	$5.6
Sanitary/Process Water Sewers	Alternative 2: Installation of Access Restrictions to exceedance area.	$4.8	$3.6
Chemical Sewers	Alternative 3a: Direct Thermal Desorption of principal threat volume; Placement of remaining exceedance soils in on-post landfill; Backfill of excavation with borrow soil.	$19	$17
Complex Trenches	Alternative 5b: Consolidation of exceedance areas outside trench anomalies; Installation of Caps/Covers over trench anomalies; Installation of vertical barriers around trench anomalies.	$37	$30

Table 20.1-16 Summary of Preferred Alternatives

Medium/Subgroup Group	Preferred Alternative	Adjusted Cost (in Millions)	Adjusted Present Worth Cost (in Millions)
Shell Trenches	Alterntave 14: Incineration/Pyrolysis of organic exceedance volume; Placement of treated soils in On-post landfill; Backfill of excavation with borrow soil.	$100	$94
Hex Pit	Alterntave 14: Incineration/Pyrolysis of organic exceedance volume; Placement of treated soil in on-post landfill; Backfill of excavation with borrow soil.	$3.7	$3.5
Sanitary Landfills	Alternative 3: Placement of exceedance soil in on-post landfill.	$32	$29
Section 36 Lime Basins	Alternative 6d: Augmentation of existing cap with additional Caps/Covers.	$6.5	$4.9
Buried M-1 Pits	Alternative 10: Direct Solidification/Stabilization of exceedance soil.	$5.1	$4.3
South Plants Central Processing Area	Alterative 6a: Direct Thermal Desorption and Direct Solidification/Stabilization of principal threat volume; Installation of Caps/Covers over entire exceedance area.	$100	$91
South Plants Ditches	Alternative 6b: Direct Thermal Desorption of principal threat volume; Consolidation of remaining area in Basin A; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$7.7	$7.0
South Plants Tank Farm	Alternative 16a: In Situ Physical/Chemical Treatment of volatile organics.	$9.5	$8.0
South Plants Balance of Areas	Alternative 6b: Direct Thermal Desorption of principal threat volume; Consolidation of remaining area in Basin A; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$32	$29

Table 20.1-16 Summary of Preferred Alternatives

Medium/Subgroup Group	Preferred Alternative	Adjusted Cost (in Millions)	Adjusted Present Worth Cost (in Millions)
Buried Sediments	Alternative 6g: Consolidation of exceedance area in Basin A; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$6.1	$6.1
Sand Creek Lateral	Alternative 6g: Consolidation of exceedance area in Basin A; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$1.5	$1.5
Section 36 Balance of Areas	Alternative 6g: Consolidation of exceedance area in Basin A; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$25	$22
Burial Trenches	Alternative 3: Placement of exceedance soil in on-post Landfill.	$7.4	$6.5
<u>Biota</u>			
Lake Sediments	Biota Alt. B1a: Consolidation of human health exceedance soil in Basin A; Installation of Caps/Covers over consolidation area; No Additional Action for remaining area.	$7.7	$5.7
Surficial Soils	Biota Alt. B9: In Situ Biological Treatment of biota exceedance area.	$3.7	$2.8
Ditches/Drainage Areas	Biota Alt. B5a: Consolidation of biota exceedance area; Installation of Caps/Covers over consolidation area; Backfill of excavation with borrow soil.	$1.1	$1.1
<u>Agent</u>			
North Plants	Agent Alt. A4: Incineration/Pyrolysis of agent contaminated soil.	$0.40	$0.36

Table 20.1-16 Summary of Preferred Alternatives

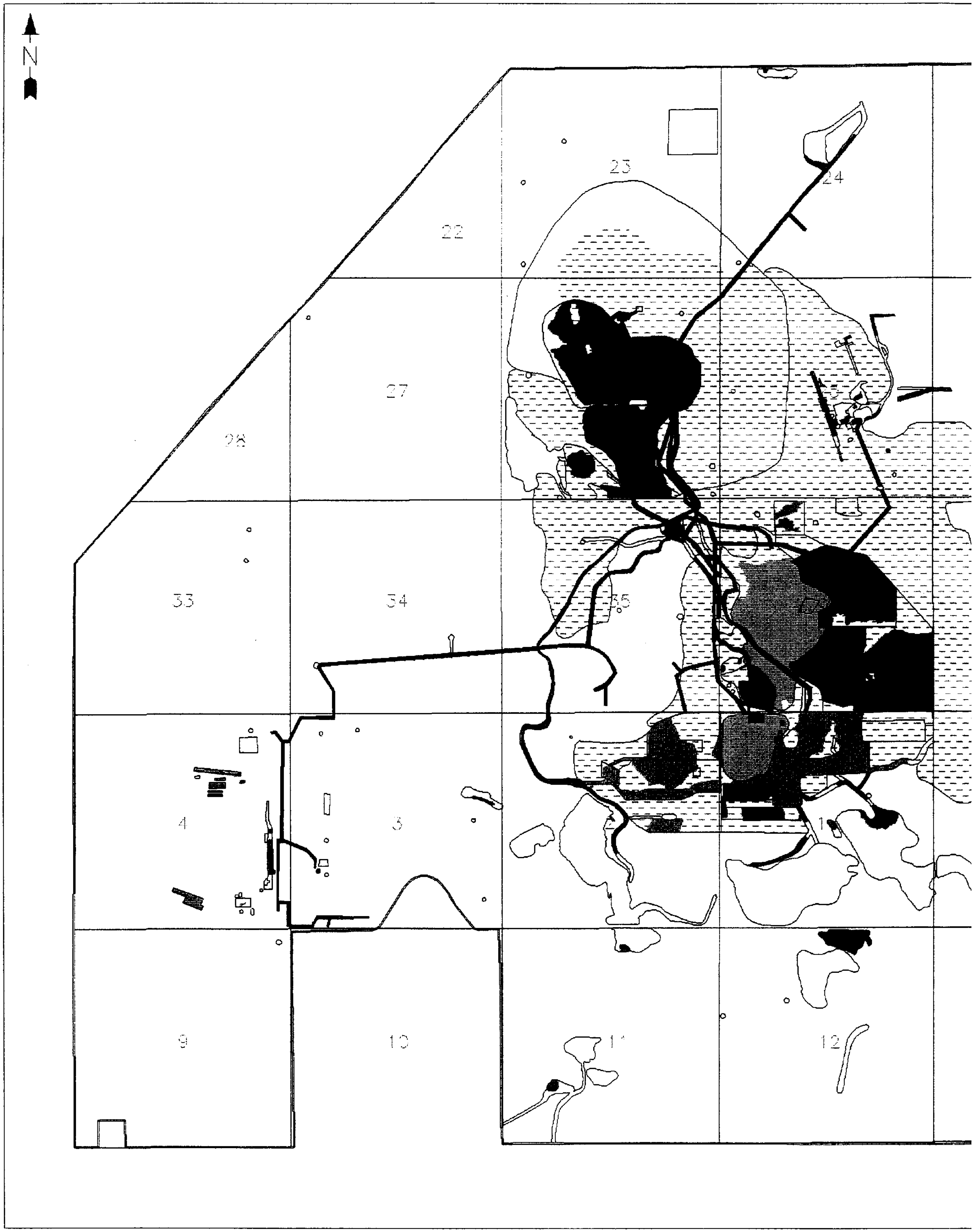
Medium/Subgroup Group	Preferred Alternative	Adjusted Cost (in Millions)	Adjusted Present Worth Cost (in Millions)
Toxic Storage Yards	Agent Alt. A4: Incineration/Pyrolysis of agent contaminated soil.	$3.2	$3.1
<u>UXO</u>			
Munitions Testing	UXO Alt. U4a: Detonation of UXO at off-post Army facility; Disposal of excavated materials/debris in on-post Landfill.	$8.0	$7.4
	<u>Preferred Alternative Total</u>:	$610	$530

Table 20.7-1 Summary of Cost Sensitivity Analysis

Medium/Submedium Group	Preferred Alternative	Cost for 50% Volume Increase (in millions)	Cost for 30% Volume Decrease (in millions)	Cost for 50% Unit Cost Increase (in millions)	Cost for 30% Unit Cost Decrease (in millions)
Basin A	Alternative 6f	40	39	40	39
Basin F Wastepile	Alternative 6e	9.2	9.2	9.2	9.2
Secondary Basins	Alternative 6g	16	9.3	12	12
Former Basin F	Alternative 6c	110	66	110	67
Basin F Exterior	Alternative 6g	6.9	4.9	5.6	5.6
Sanitary/Process Water Sewers	Alternative 2	3.7	3.7	3.7	3.7
Chemical Sewers	Alternative 3a	24	13	22	13
Complex Trenches	Alternative 5b	32	26	29	25
Shell Trenches	Alternative 14	130	73	140	67
Hex Pit	Alternative 14	4.6	2.7	5.1	2.5
Sanitary Landfills	Alternative 3	43	21	29	29
Section 36 Lime Basins	Alternative 6d	4.9	4.9	4.9	4.9
Buried M-1 Pits	Alternative 10	6.2	3.1	6	3.2
South Plants Central Processing	Alternative 6a	130	69	130	70
South Plants Tank Farm	Alternative 16a	8	8	8	8
South Plants Ditches	Alternative 6b	10	5.1	6.2	5.1

Table 20.7-1 Summary of Cost Sensitivity Analysis

Medium/Submedium Group	Preferred Alternative	Cost for 50% Volume Increase (in millions)	Cost for 30% Volume Decrease (in millions)	Cost for 50% Unit Cost Increase (in millions)	Cost for 30% Unit Cost Decrease (in millions)
South Plant Balance	Alternative 6a	41	22	25	22
Buried Sediments	Alternative 6g	8.9	4.4	6.1	6.1
Sand Creek Lateral	Alternative 6g	2.1	1.2	1.5	1.5
Section 36 Balance	Alternative 6g	30	18	23	22
Burial Trenches	Alternative 3	9	5	6.5	6.5
Lake Sediments	Alternative B1a	7.3	4.8	5.7	5.7
Surficial Soils	Alternative B9	2.8	2.8	2.8	2.8
Ditches/Drainage Areas	Alternative B5a	1.5	0.80	1.1	1.1
North Plants	Alternative A4	0.41	0.40	0.38	0.35
Toxic Storage	Alternative A4	3.2	3	3.1	3
Munitions Testing	Alternative U4a	9.8	5.9	7.4	7.4
	Total	690	430	630	450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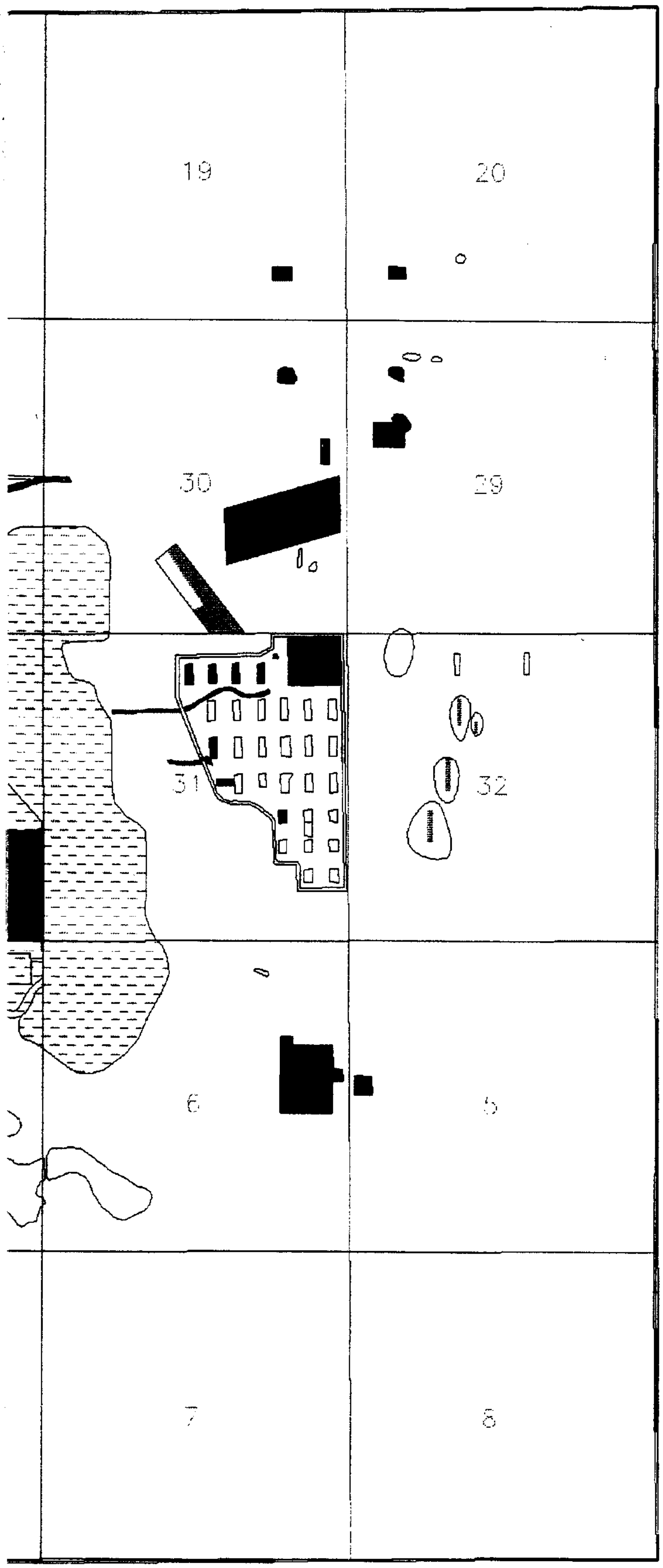


Legend

- Arsenal Boundary
- Incineration
- Thermal Desorption of Principal Threat Volumes; Caps/Covers[1]
- Thermal Desorption of Principal Threat Volumes; Consolidation
- Direct Solidification/Stabilization
- Caps/Covers
- Consolidation
- Thermal Desorption of Principal Threat Volumes; Landfill
- Landfill
- Soil Vapor Extraction
- In Situ Agricultural Practices
- Access Restrictions
- SARsite Boundary
- 5 Section Number

[1] Solidification/Stabilization included for Principal Threat Vloume with Inorganic Exceedance for South Plants Central Processing Area

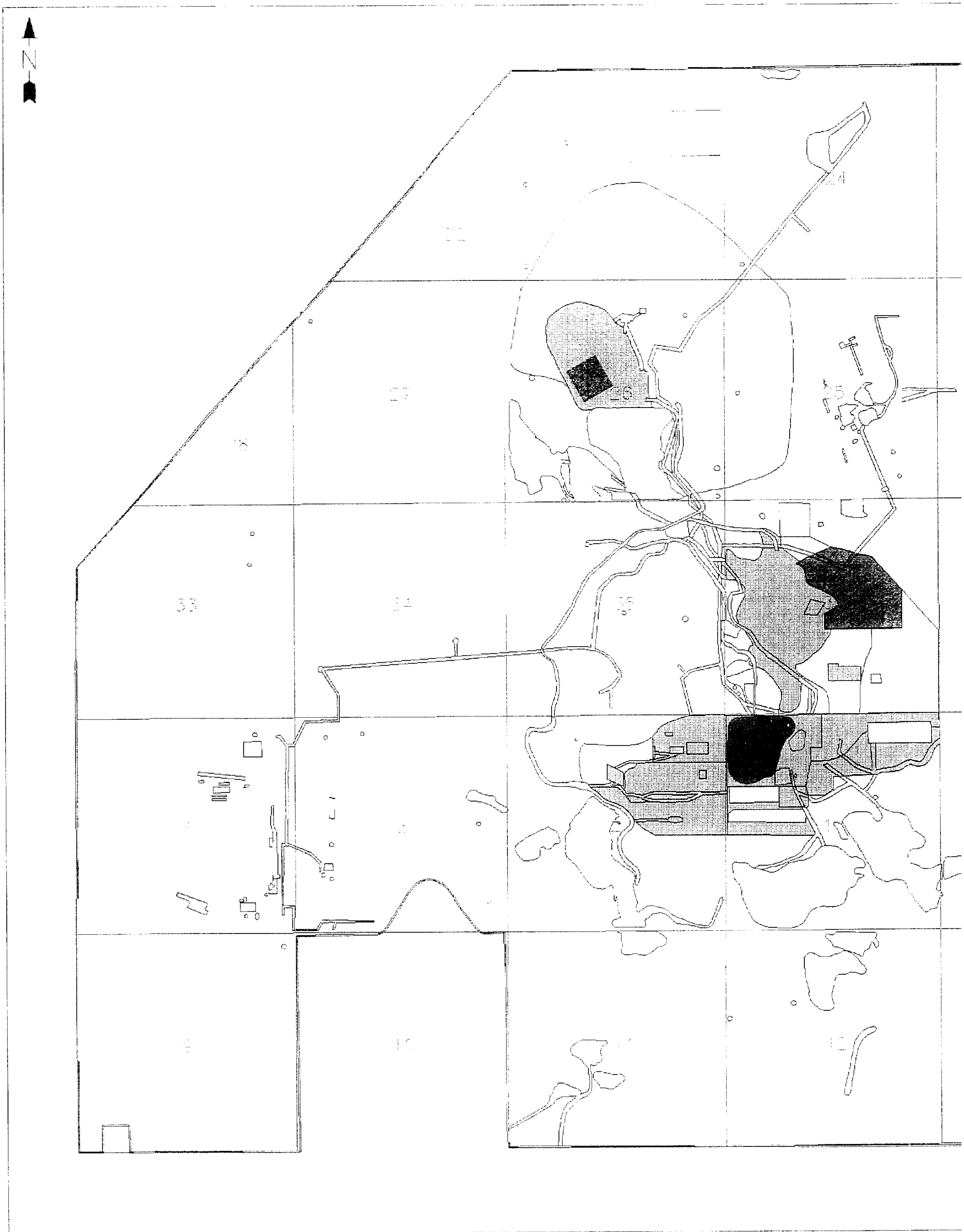
1500 0 1500 3000 Feet

Prepared for: U.S. Army Program Manager for Rocky Mountain Arsenal

Figure 20.1-1

Summary of Preferred Soils Alternatives

Ebasco Services Incorporated
July 1993



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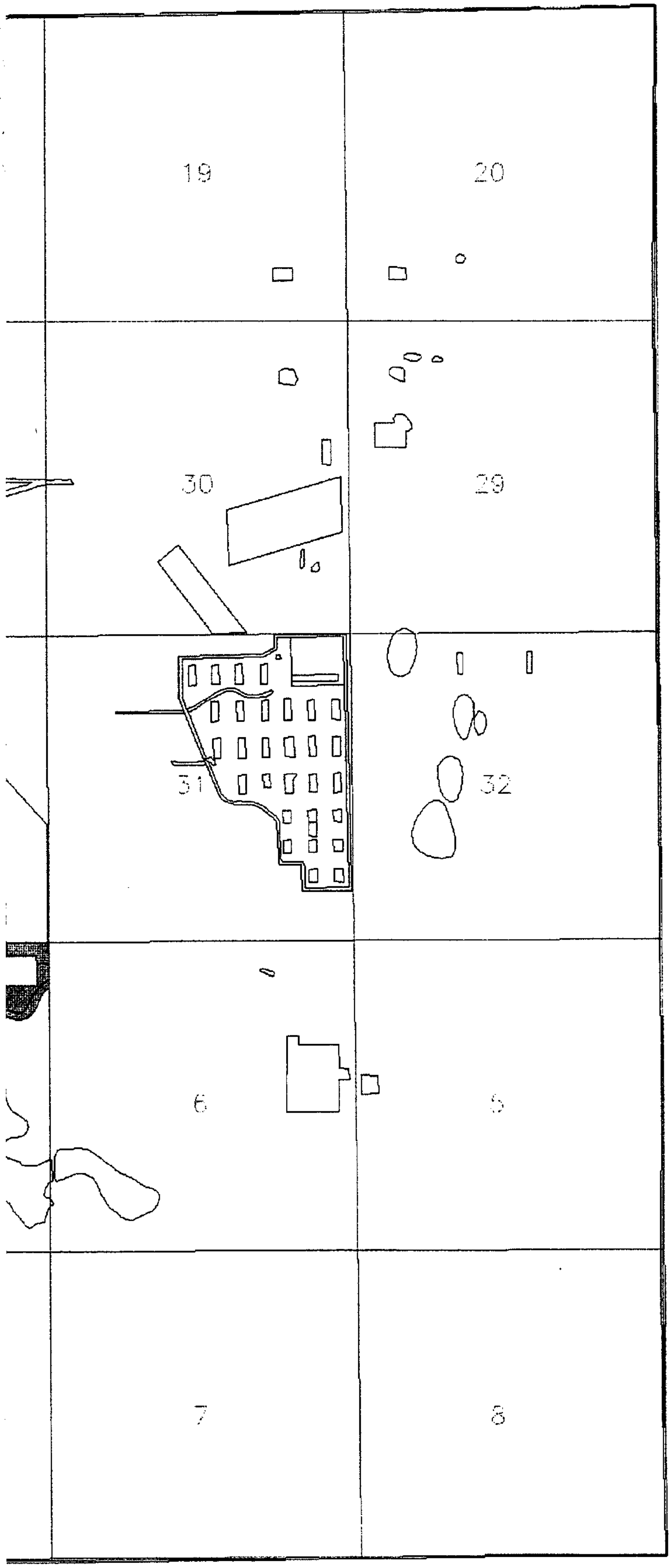


Legend

- Arsenal Boundary
- Thermal Desorption of Principal Threat Area
- Direct Solidification of Principal Threat Area
- Thermal Desorption and Direct Solidification of Principal Threat Area
- Cap/Cover of Principal Threat Area
- SARsite Boundary
- 5 Section Number

1500 0 1500 3000 Feet

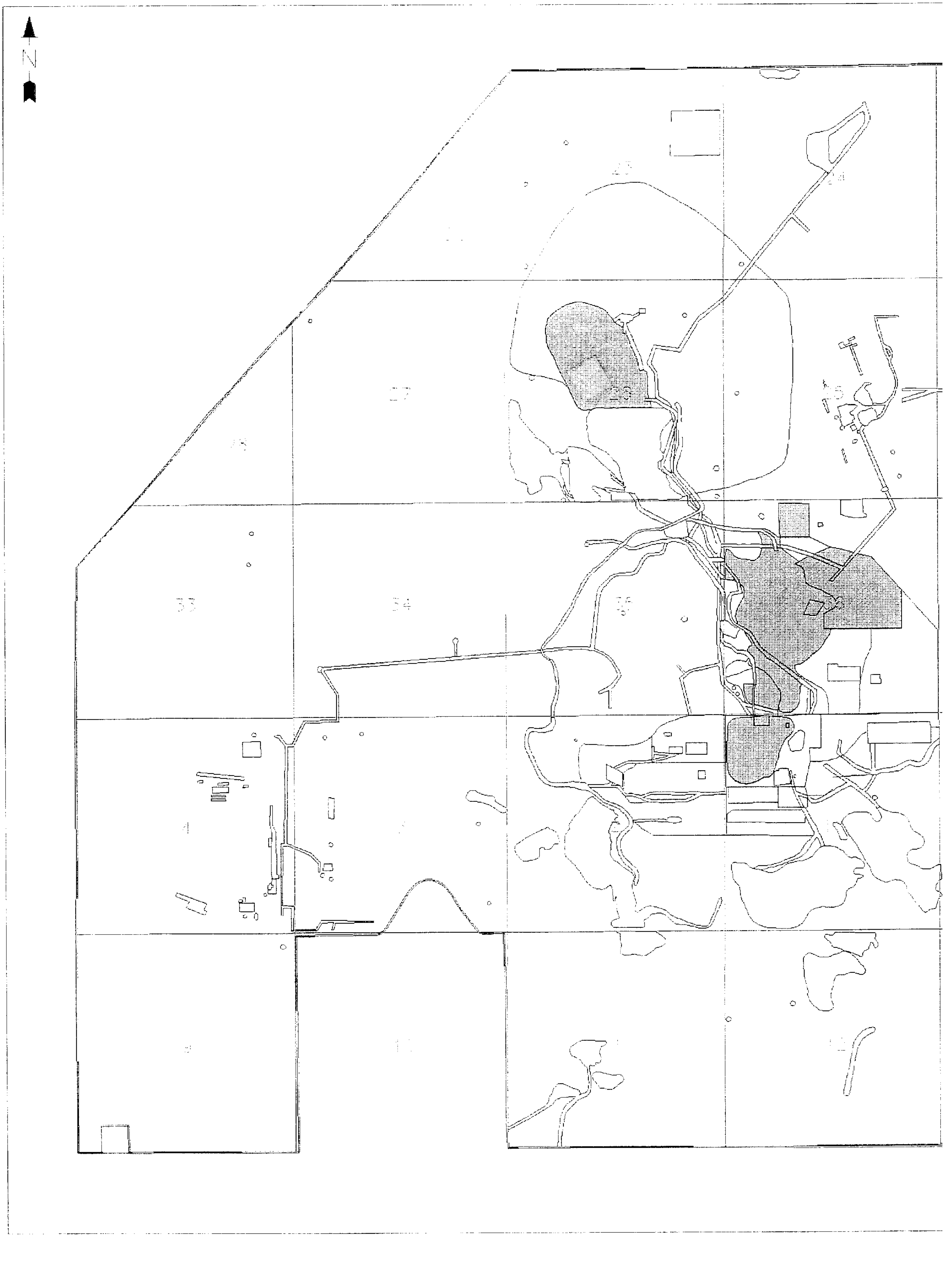
Prepared for: U.S. Army Program Manager for Rocky Mountain Arsenal

Figure 20.1-2

Preferred Principal Threat Alternatives

(Note: Entire Site Shown)

Ebasco Services Incorporated
July 1993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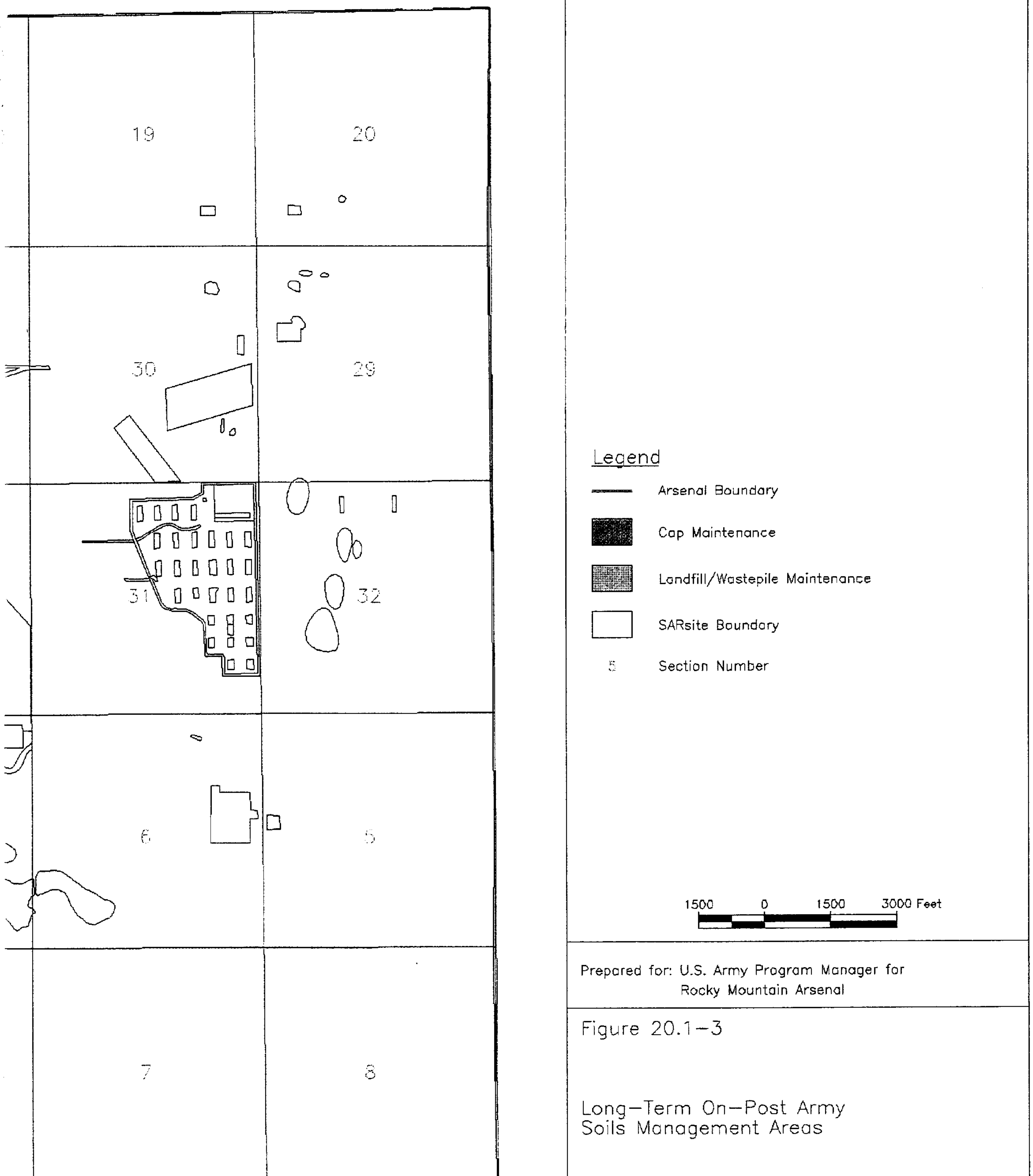
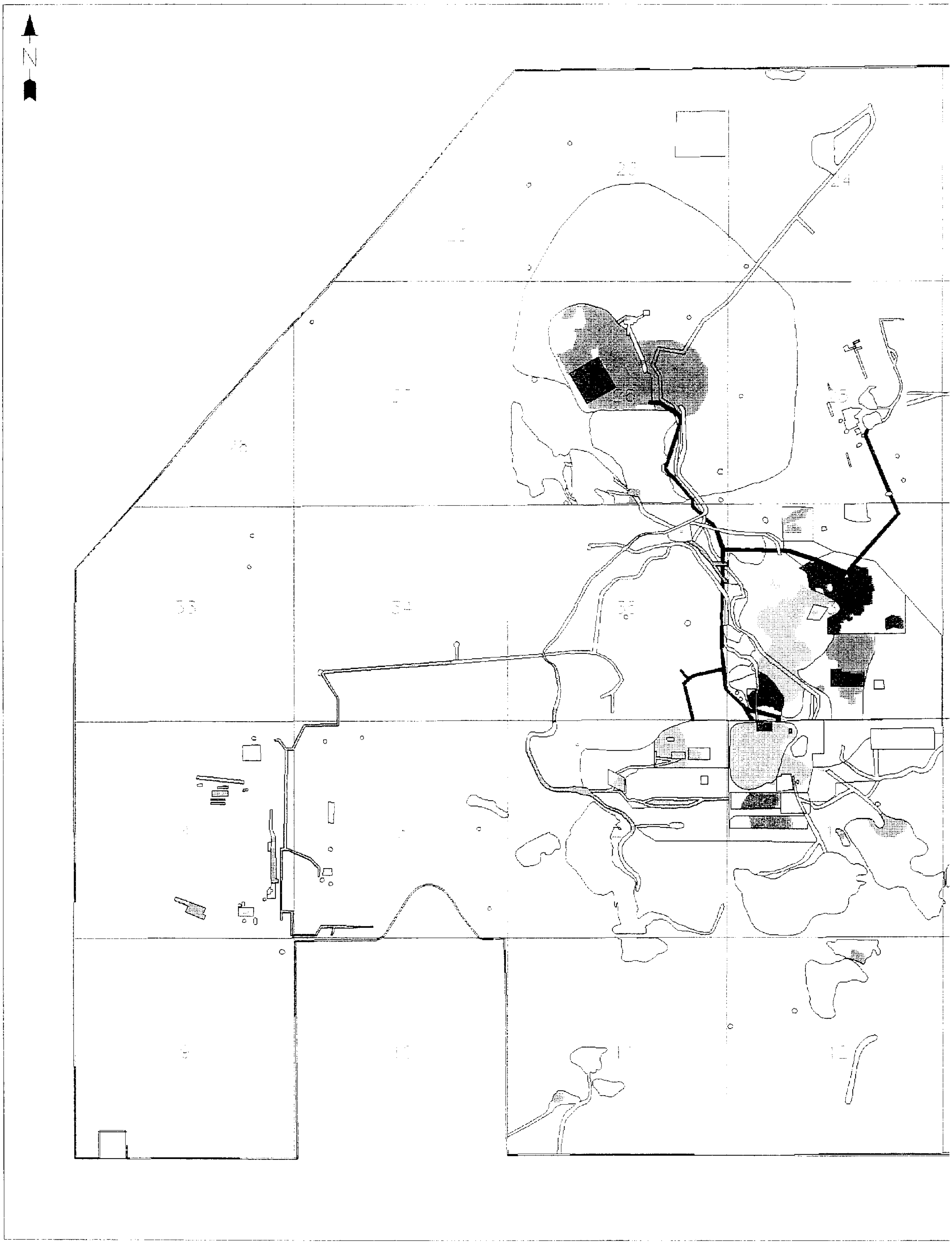


Prepared for: U.S. Army Program Manager for
Rocky Mountain Arsenal

Figure 20.1-3

Long-Term On-Post Army
Soils Management Areas

Ebasco Services Incorporated
July 1993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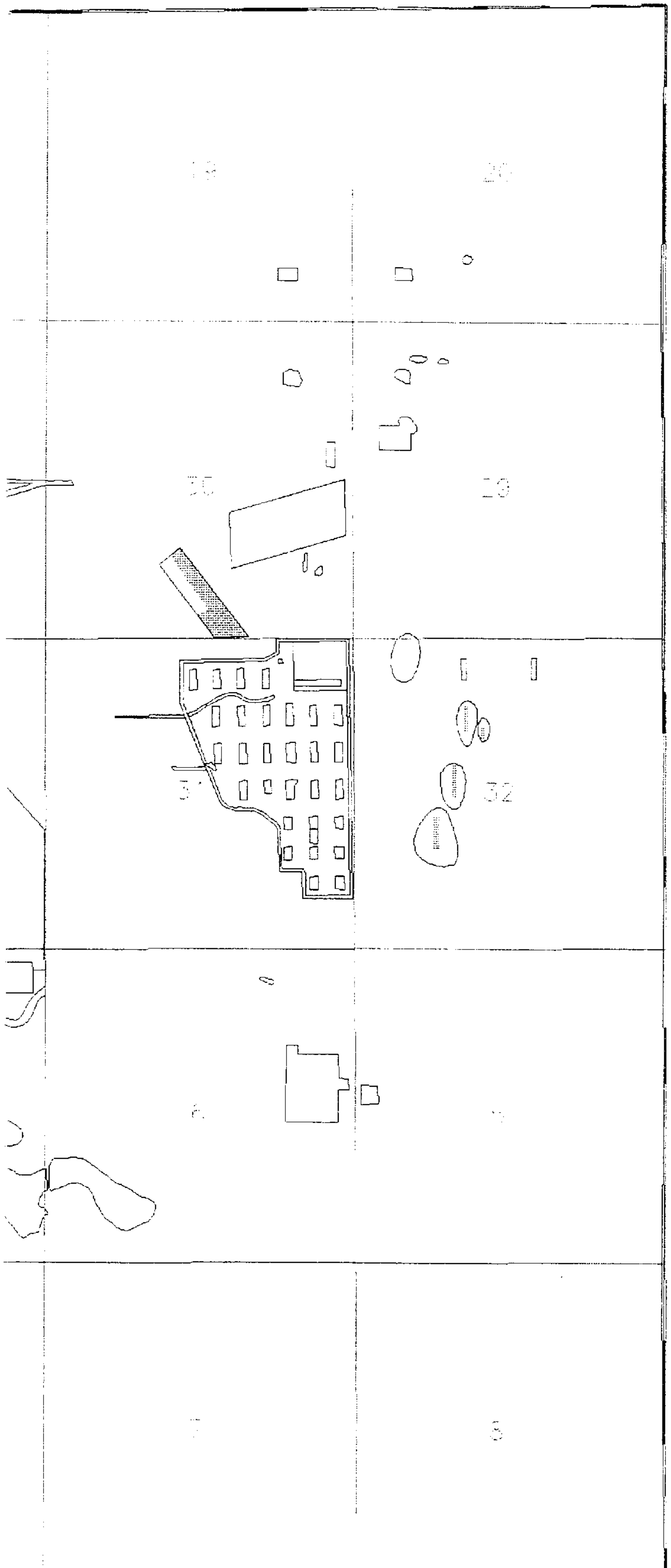


Legend

Arsenal Boundary

Incineration

Thermal Desorption of Principal Threat Volumes; Caps/Covers[1]

Thermal Desorption of Principal Threat Volumes; Consolidation

Direct Solidification/Stabilization

Caps/Covers

Consolidation

Thermal Desorption of Principal Threat Volumes; Landfill

Landfill

Soil Vapor Extraction

Access Restrictions

SARsite Boundary

5 Section Number

[1] Solidification/Stabilization included for Principal Threat Volume with Inorganic Exceedance for South Plants Central Processing Area

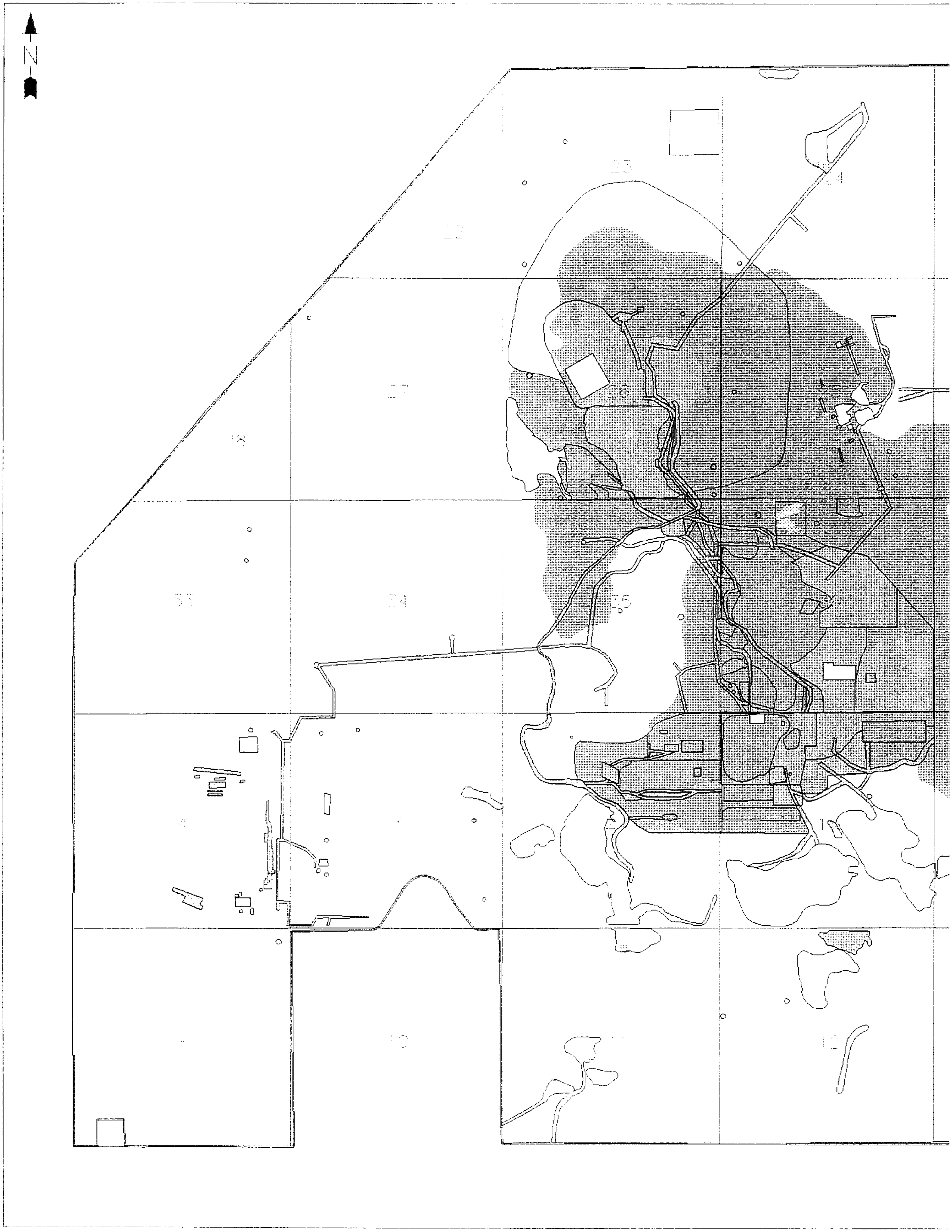
1500 0 1500 3000 Feet

Prepared for: U.S. Army Program Manager for Rocky Mountain Arsenal

Figure 20.2-1

Summary of Preferred Alternatives for Human Health Exceedance Areas

Ebasco Services Incorporated
July 1993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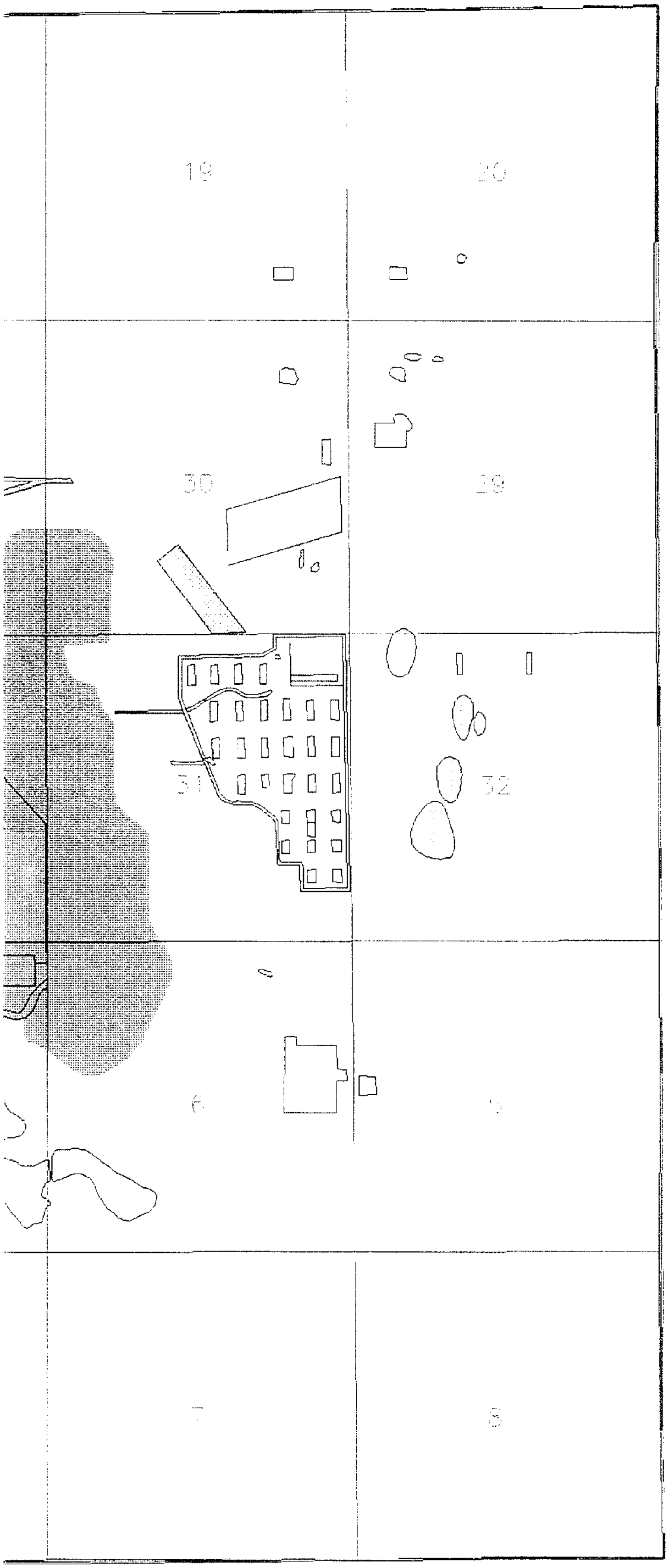


Legend

Arsenal Boundary

In Situ Agricultural Practices

Caps/Covers

Consolidation

Landfill

SARsite Boundary

Section Number

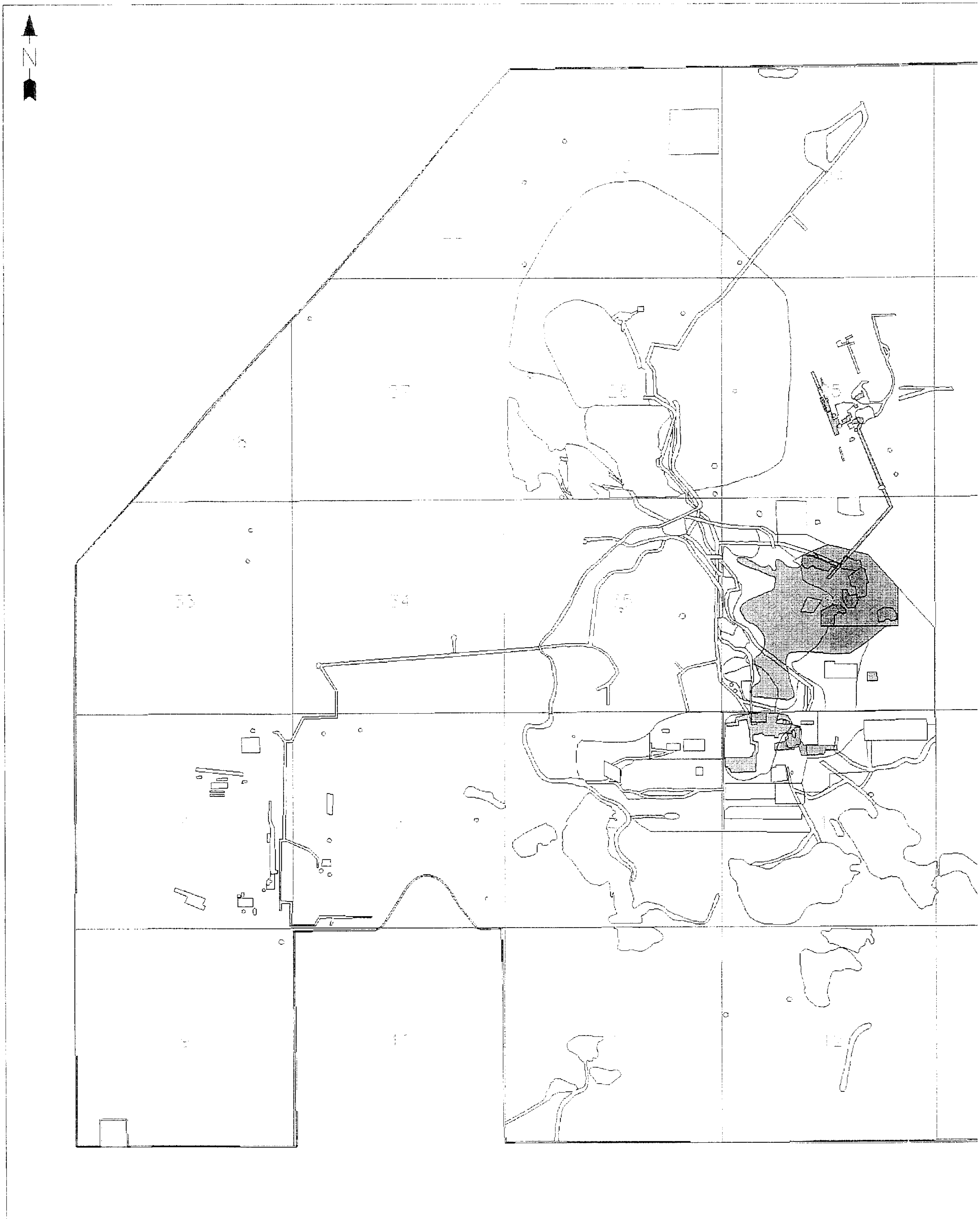
1500 0 1500 3000 Feet

Prepared for: U.S. Army Program Manager for
Rocky Mountain Arsenal

Figure 20.3-1

Summary of Preferred Alternatives
for Biota Exceedance Areas

Ebasco Services Incorporated
July 1993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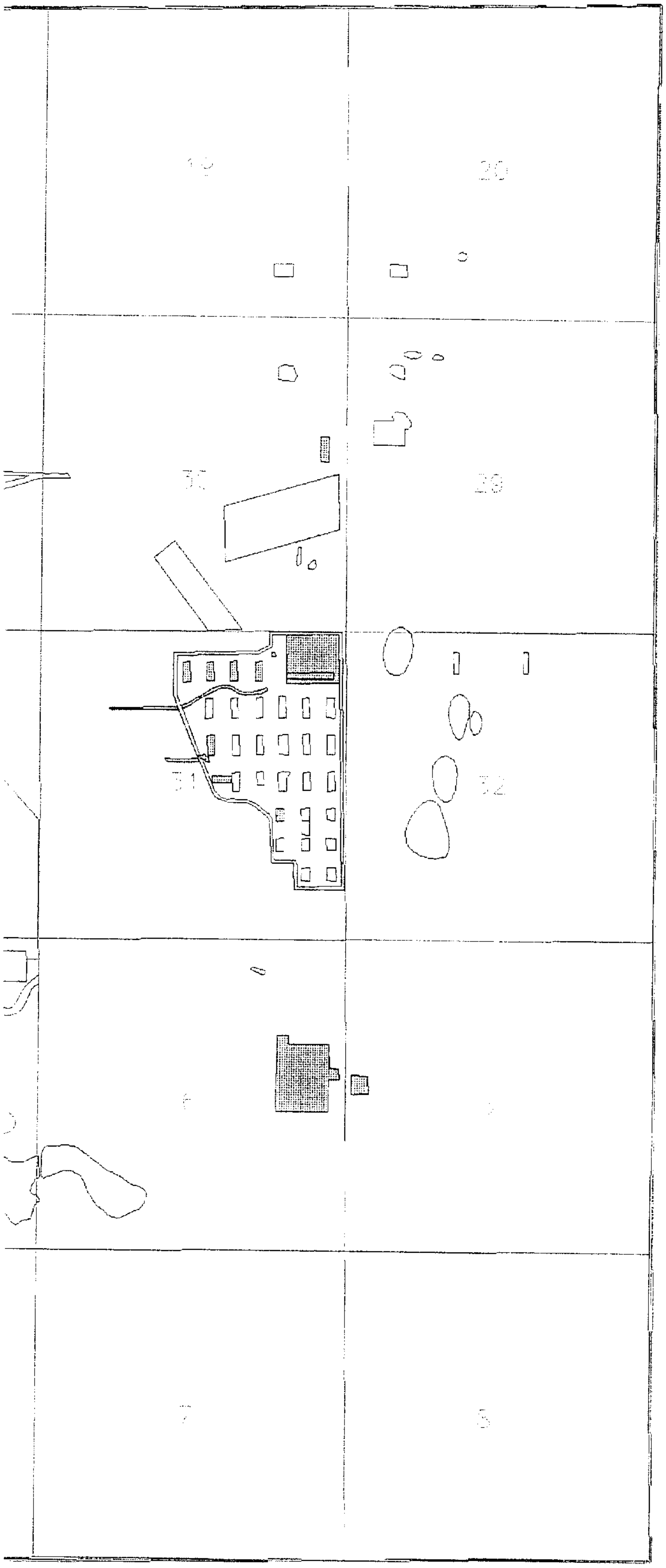

Legend

Arsenal Boundary

Agent Area Screened

Agent Area Capped

Principal Threat Areas Screened and Remainder of Area Capped

SARsite Boundary

5 Section Number

1500 0 1500 3000 Feet

Prepared for U.S. Army Program Manager for Rocky Mountain Arsenal

Figure 20.4-1

Summary of Preferred Alternatives for Areas with Potential Agent Presence

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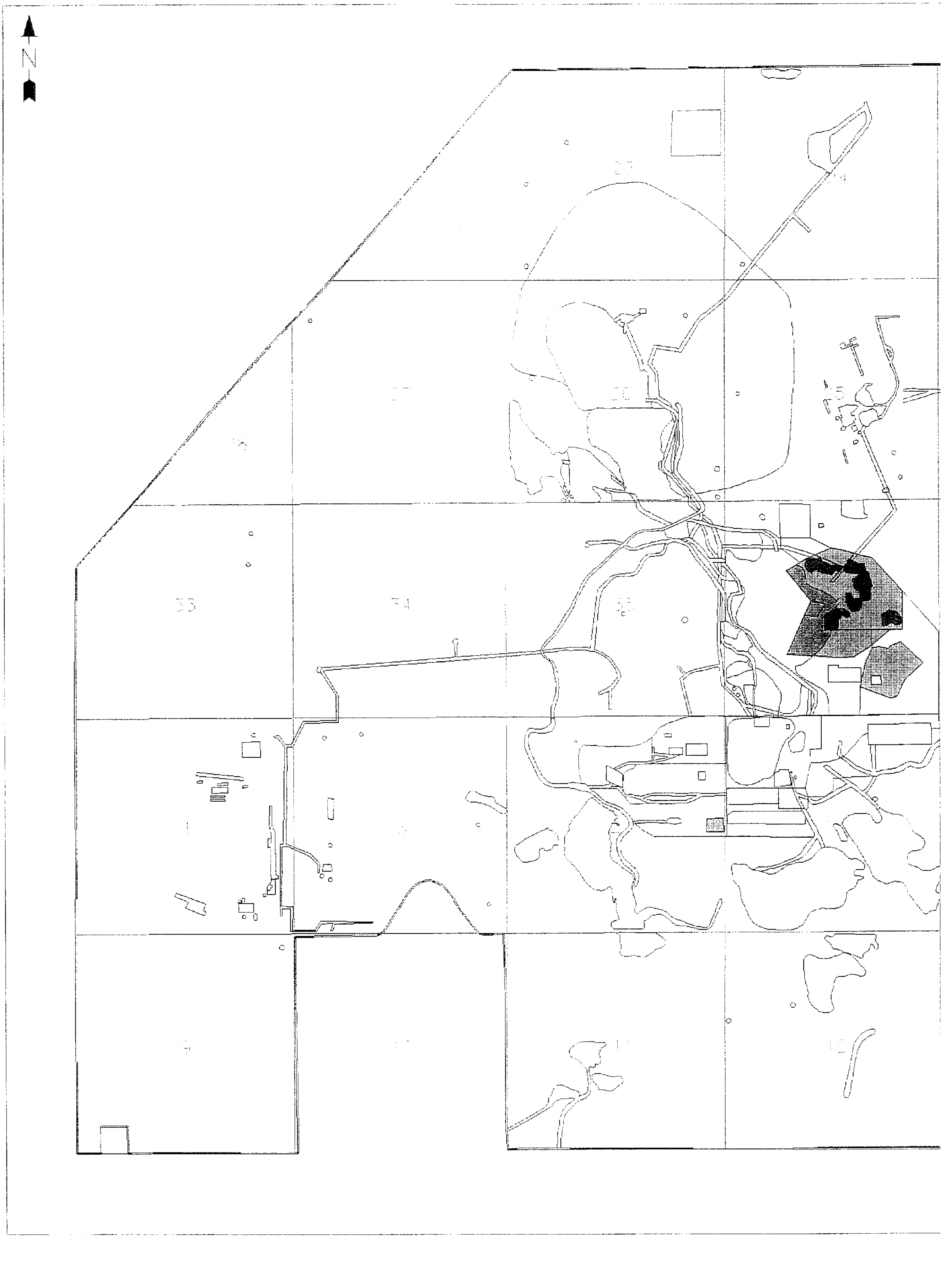

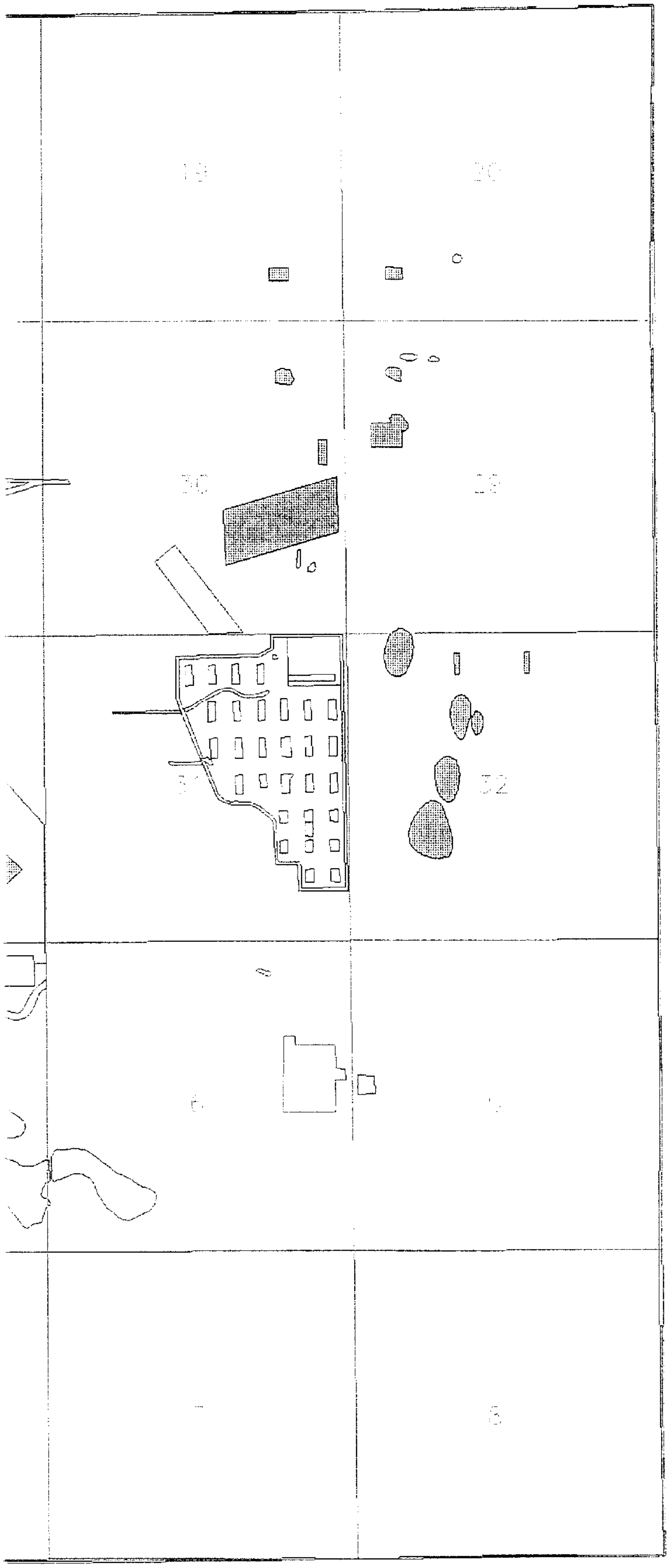

Legend

Arsenal Boundary

UXO Area Cleared

UXO Area Capped

Principal Threat Areas Cleared and Remainder of Area Capped

SARsite Boundary

5 Section Number

1500 0 1500 3000 Feet

Prepared for: U.S. Army Program Manager for Rocky Mountain Arsenal

Figure 20.5-1

Summary of Preferred Alternatives for Areas with Potential UXO Presence

Ebasco Services Incorporated
July 1993

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